BIOLOGICAL INVENTORY STUDY PLAN FOR THE CENTRAL ALASKA NETWORK

Denali National Park and Preserve
Wrangell-St. Elias National Park and Preserve
Yukon-Charley Rivers National Preserve

Target Budget Allocation: $812,000

November 17, 2000

Submitted by:

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In combination with the following Principal Investigators:

Plant Inventory
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Carl Roland, Plant Ecologist, Denali National Park and Preserve, Alaska.

Small Mammal Inventory
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Freshwater Fish Inventory
Eric Veach, Fishery Biologist, Wrangell-St. Elias National Park and Preserve, Alaska.

EXECUTIVE SUMMARY

The Servicewide Inventory and Monitoring Program of the National Park Service (NPS) is currently coordinating systematic efforts to conduct biological inventories documenting the occurrence, distribution, and relative abundance of vertebrate (mammals, fish, birds, and amphibians) and vascular plant species in the parks. The 256 NPS units eligible for this funding were divided into multi-park networks, 4 of which are in the Alaska Region. This inventory study plan was developed for the Central Alaska Network which is composed of Denali National Park and Preserve (DENA), Wrangell-St. Elias National Park and Preserve (WRST), and Yukon-Charley Rivers National Preserve (YUCH).

Park staffs and biological taxa experts developed the inventory goals for the Central Alaska Network during an extensive scoping meeting held in Anchorage, Alaska in April 2000. These taxa-specific goals were based on existing baseline information, identified management information needs, and the number of expected versus documented species. The network goals are to:

1. Conduct targeted **plant inventories** that will result in documentation of the occurrence of 90% of the plant species currently estimated to exist in each park in the Central Alaska Network;
2. Conduct **small mammal (shrews, voles, and small weasels) inventories** that will result in documentation of the occurrence, distribution, and abundance of 90% of these small mammal species currently estimated to exist in each park in the Central Alaska Network; and
3. Conduct **freshwater (including anadromous) fish inventories** that will result in documentation of the occurrence and distribution of 90% of the freshwater fish species currently estimated to exist in each park in the Central Alaska Network.

Park staff members with expertise in these inventory areas were available within the network and were recruited as principal investigators to develop detailed project descriptions for each of these goals.

All three inventories will be conducted in each Central Alaska Network park over the next 3 years according to the following rotation:

Inventory	**FY01**	**FY02**	**FY03**	**FY04**
Plants	DENA	WRST	YUCH	Final data analysis and write up
Small Mammals	YUCH	DENA	WRST	
Freshwater Fish	WRST	YUCH	DENA	

Of the $942,915 allocated to the Central Alaska Network for conducting this inventory work, $130,915 (23%) was allocated to a regional contract with the Alaska Natural Heritage Program to compile and verify historical and predicted species data for each park in the Alaska Region. Information collected through this contract will be entered into the NPS databases NRBib,

NPSpecies, and the Dataset Datalog. The remaining $812,000 was distributed between the 3 network inventories with the resultant division of inventory budget allocations:

Inventory Component	**Funding Level**
Preproposal work	130,915
Plant Inventory	316,000
Small Mammal Inventory	225,500
Freshwater Fish Inventory	270,500
Grand Total	$942,915

All principal investigators and the Network Inventory Coordinator (Shelli Swanson; YUCH) are currently on network park staffs; park base funding from their respective parks will cover their salaries, office spaces, and supplies. DENA will provide budget assistance for all network projects.

Inventory work in the Central Alaska Network is being coordinated by a group consisting of the Resource Management Division Chiefs at each park--Patty Rost (YUCH), Devi Sharp (WRST) and Gordon Olson (DENA); the park leads--Shelli Swanson (YUCH), Mary Beth Cook (WRST) and Carl Roland (DENA); and the Alaska Region I&M Coordinator (Sara Wesser). Shelli Swanson also serves as the Central Alaska Network Coordinator and the representative to the Alaska Region I&M Steering Committee. These individuals are involved in all major decisions pertaining to inventory priorities, project development, and program oversight.

Park Management Approval
Central Alaska Network

We, the Superintendents of the Central Alaska Network, hereby fully support this inventory of Vertebrates and Vascular Plants Study Plan with the understanding that this information will assist the parks, and network as a whole, in managing natural resources with sound scientific data. We will support this effort to ensure the success of this project.

for Superintendent, Denali National Park and Preserve — Date 1/25/01

Superintendent, Wrangell-St. Elias National Park and Preserve — Date Jan. 26, 2001

Superintendent, Yukon-Charley Rivers National Preserve — Date Jan 26, 2001

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INTRODUCTION

National Park Service Inventory and Monitoring Program

The National Park Service's (NPS) primary mission is to conserve unimpaired the natural and cultural resources of the national park system for the enjoyment of this and future generations. Currently, the Service is unable to attain its mission in many parks, owing to a serious lack of scientific information about the nature and condition of their biological resources. In addition to a lack of basic information about biological resources in its parks, NPS generally lacks credible information about the current status of those resources and how they are changing over time in response to the myriad of threats and issues impacting those resources.

To address this general lack of credible information about park resources, Congress passed the National Parks Omnibus Management Act in 1998, which mandated the establishment of NPS inventory and monitoring programs to establish baseline and long-term trend information for National Park System resources. This was accomplished through increased funding to the Servicewide Inventory and Monitoring (I&M) Program of the National Park Service. The I&M program is currently coordinating systematic efforts to conduct biological inventories documenting the occurrence, distribution, and relative abundance of vertebrate (mammals, fish, birds, and amphibians) and vascular plant species in the parks.

The basic management goal of the I&M biological inventory program is to provide park managers with comprehensive, scientifically based information about the status of selected biological resources occurring within park boundaries; this information will be used for making management decisions, conducting and directing scientific research, and educating the public. The inventories will also lay the groundwork necessary for park managers to develop effective monitoring programs and management strategies for park biological resources.

To attain these basic goals, the I&M program developed the following program objectives:

1. To document through existing, verifiable data and targeted field investigations the occurrence of at least 90 percent of the species of vertebrates and vascular plants currently estimated to occur in the park.
2. To describe the distribution and relative abundance of species of special concern, such as Threatened and Endangered species, exotics, and other species of special management interest occurring within park boundaries.
3. To provide the baseline information needed to develop a general monitoring strategy and design that can be implemented by parks once inventories have been completed, tailored to specific park threats and resource issues.

To administer the I&M program, the 256 NPS units eligible for this funding were divided into multi-park networks. Inventory study plans were required from each network specifying how the above objectives would be met. Four of the I&M networks are located in the Alaska Region. This inventory study plan was developed for the Central Alaska Network.

Central Alaska Network Parks

The Central Alaska Network (Figure 1) consists of Denali National Park and Preserve (DENA), Wrangell-St. Elias National Park and Preserve (WRST), and Yukon-Charley Rivers National Preserve (YUCH). These park units contain over 21.7 million acres of parklands with 11.8

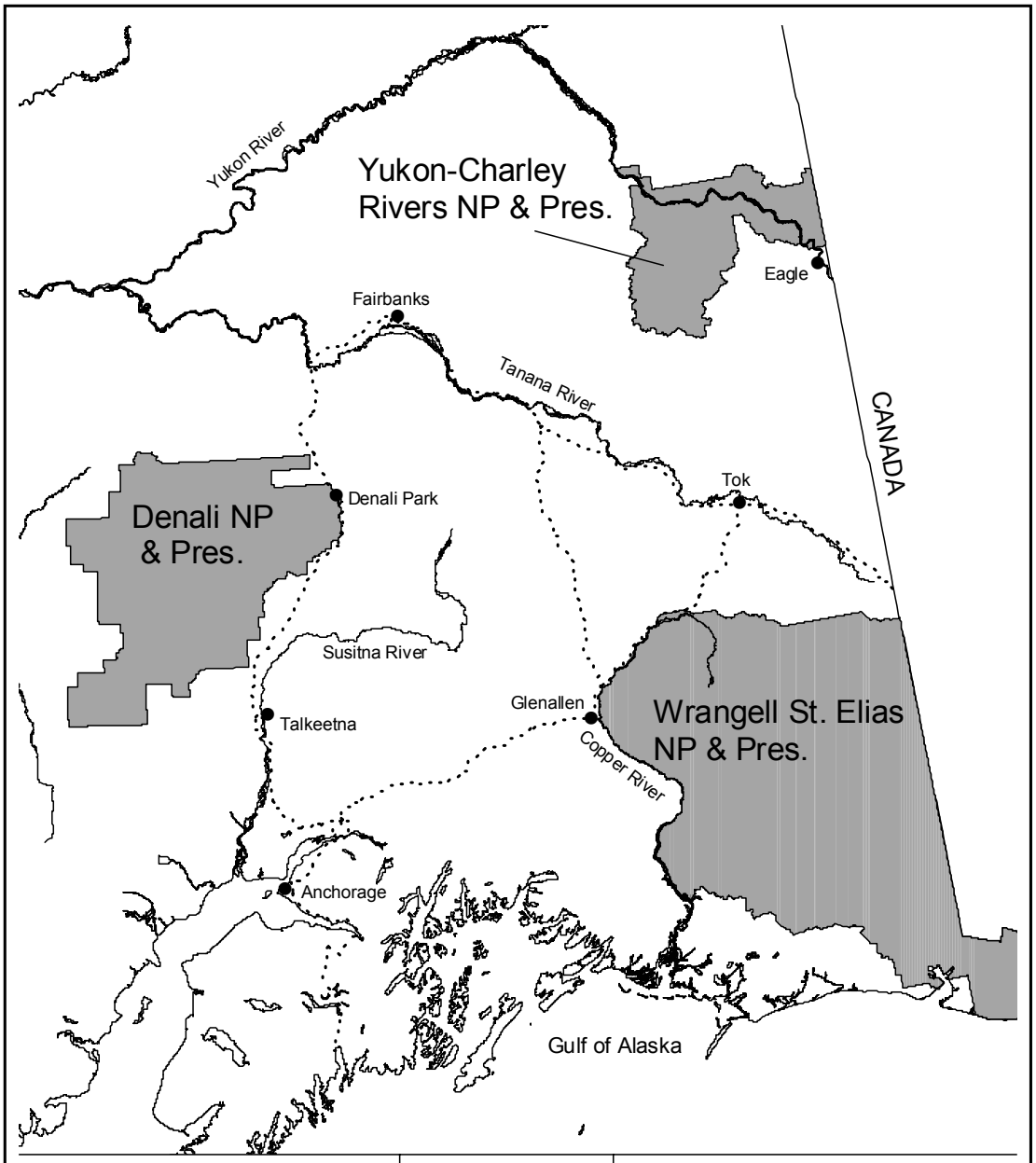

Figure 1. Location of the 3 NPS park units in the Central Alaska Network.

Plot date: October 2, 2000 p:\multi-park\naturalresources\canmap.apr

million acres of officially designated wilderness and several million more of suitable wilderness lands. Based on total acreage, the Central Alaska Network represents 25% of the land in the National Park System. The Central Alaska Network is ecologically very diverse. The network ranges in elevation from sea level in WRST to the highest mountain in North America in DENA; between these elevations it passes through the lower mountains and drainages of YUCH, which typify interior Alaska. Consequently, the network encompasses an incredible diversity of landscapes, plant communities, and faunal assemblages.

Denali National Park and Preserve (6.0 million acres) extends from the southern flanks of the central Alaska Range over the crest into the northern foothills and wetland areas. Over one-third of DENA is composed of mountains and ridges above 4,000 feet elevation; this area includes the massive Mt. McKinley, which at 20,320 feet, is the highest mountain in North America. DENA's diverse subarctic vegetation communities populate a variety of landscapes ranging through thermokarsted lowland plains, rolling tundra foothills, and rugged alpine areas. The area supports a diverse assemblage of flora and fauna. DENA has 2.1 million acres of officially designated wilderness and is designated as an International Biosphere Reserve.

Wrangell-St. Elias National Park and Preserve (13.2 million acres) contains North America's largest assemblage of glaciers and its greatest collection of peaks over 16,000 feet in elevation. The Malaspina glacier is the largest piedmont glacier in North America. The diverse landforms, varied climatic zones, and complex geologic and ecologic history in WRST have created a mosaic of vegetation types and unique plant communities that support a variety of wildlife species. The park contains 9.7 million acres of designated wilderness and is part of an international World Heritage Site that also includes Glacier Bay National Park and Preserve and two Canadian parks.

Yukon-Charley Rivers National Preserve (2.5 million acres) contains 115 miles of the legendary Yukon River and the entire pristine Charley River watershed. The preserve is located on the original continental margin (some of the most ancient terrain in Alaska); a nearly complete geological record (Precambrian to present) is represented in its sedimentary rock layers. The preserve contains 2.2 million acres of lands suitable for wilderness designation. Relict arctic steppe communities are found on its steep, dry, south-facing slopes and contain 8 rare plant species. The avifauna in YUCH is very diverse and abundant and supports the highest nesting density of American peregrine falcons (*Falco peregrinus anatum*) in North America. YUCH's Dall sheep (*Ovis dalli*) population is noted for its travel through boreal forest from high mountain areas to river bluffs along the Charley and Yukon Rivers.

Biological Management Issues and Concerns

A primary management issue for the Central Alaska Network parks is lack of basic resource (presence/absence, distribution, and abundance) information. This extensive data void prevents informed management decisions on nearly all resource questions. Excepting the original Mt. McKinley National Park (established in 1917), the Central Alaska Network parks are only 20 years old, are composed of huge acreages of access-inhibited lands, and have been underfunded and understaffed for conducting basic inventory work since their inception. Consequently, park management staffs are uncertain 1) if they have exotics, threatened, endangered, or rare species or communities, 2) what the distributions, relative abundances, and habitat associations are for these species of management concern, and 3) how to predict the impacts of various management strategies on park flora and fauna populations. Data that is available often lacks organization, synthesis, and adequate archival storage. Clear data gaps exist for small mammal species (shrews, microtines, other Rodentia, pikas, and bats), marine mammals, amphibians, non-game and marine fish, vascular and nonvascular (bryophytes and lichens) plants, and invertebrates.

Management of threatened, endangered, and rare plant and vertebrate species is a critical issue for the Central Alaska Network. DENA, WRST, and YUCH all have known rare or endemic plant species and/or communities, and additional species and unique plant communities will likely be added to the list as inventory work is completed. Federally listed avian species of concern [including black poll warbler (*Dendroica striata*), harlequin duck (*Histrionicus histrionicus*), olive-sided flycatcher (*Contopus borealis*), and the recently delisted peregrine falcon (*Falco peregrinus americana*)] are found in all three park units; Kittlitz's murrelet (*Brachyramphus brevirostris*), another avian species of concern can be found in WRST. In addition, several species of alpine nesting shorebirds known only to nest in Alaska [such as surfbirds (*Aphriza virgata*)] are found within the Central Alaska Network parks and are of management concern. Steller's sea lions (*Eumeopias jubatus*; classified as threatened east of 144º Longitude and endangered west of there) are known to inhabit coastal waters near WRST. Inventory information on these species and others that will be discovered will greatly increase management efficiency for these unique species.

Human disturbance to the Central Alaska Network park units is a key management issue and has taken on many forms: 1) development on and near park lands (RS2477 transportation corridors and other roads, inholding development, and boundary development of tourist facilities); 2) resource extraction (commercial fishing, logging, gas and oil exploration, and mining); 3) military, commercial, and flightseeing activity; 4) recreational use of airboats, jetboats, jetskis, snowmachines, and ATVs; 5) recreational use impacts to beaches, plant communities, and landscapes; 6) localized habitat fragmentation and degradation; and 7) exotic introductions of non-native plants and animals. Management issues involving exotics/non-native species include locating and eradicating invasive exotic plant species. Use of domestic animals for recreational transport in parks may also result in seed dispersal of non-native plants in some areas. Of additional concern is environmental contamination due to oil spills, water pollutants from ocean vessels and other non-point sources, and air pollutants from industrial plants in Europe and Asia (Arctic haze).

A special management concern of the Central Alaska Network park units is subsistence and sport harvest management of mammals, fish, and birds. Lack of information on the distribution, relative abundance, and habitat requirements of harvested species has hampered effective hunting and trapping regulation for years. The potential for overharvest may be high in these delicately balanced ecosystems.

Status of Biological Inventories for the Central Alaska Network

To determine the status of biological inventory data for its park units, the Central Alaska Network allocated $130,322 (23% of its Inventory budget) to an Alaska Regional contract with the Alaska Natural Heritage Program (ANHP; part of the University of Alaska). Under this contract, the ANHP agreed to compile and verify historical and predicted species data for each park in the Alaska Region. This effort includes development of expected species lists and gathering and synthesizing all available information on the biological taxa of interest from gray literature and information sources, such as checklists, wildlife observation cards, trip reports, published reports, and museum specimens. ANHP staff visited each park in the Central Alaska Network in spring of 2000 to search and copy files, in-house reports, published literature, and other relevant park-based data sources for biological inventory information. The information collected is being entered into the national databases NPSpecies and NRBib as well as the Dataset Catalog and will be completed by September 2001. Customized reports derived from each database will be produced for each park and a final report summarizing the entire project will be prepared. The Alaska Region submitted preliminary copies of the NPSpecies and NRBib Alaska datasets to the Servicewide I&M Program in September 2000.

In addition to the collection of biological inventory information, the Alaska Region obtained separate funds from the I&M Program in 2000 and 2001 to develop products for habitat delineation in each park. With these funds, landscape stratification maps are being completed for each park following the U.S. Forest Service ecological land classification system (ECOMAP) at approximately the subsection level. All existing data on geomorphology, topography, surficial geology, soils, vegetation, and hydrology are being examined, interpreted, and used to delineate landscape ecosystem unit boundaries. Aerial photography and multi-spectral satellite imagery products developed by the Alaska Region Land Cover Mapping Program are also being used to refine the interpretation and boundary delineation. The landscape maps will serve as the basis for stratification and sample allocation for each park and for extrapolation of inventory results to produce park-wide and region-wide estimates of distribution and abundance. The ecological maps and documentation will be linked in the GIS Theme Manager. In the Central Alaska Network, the YUCH ecological maps have been completed, DENA has a draft available, and WRST is slated for completion in FY2001. All mapping will be completed by May 2001 and final reports will be completed by September 2001.

Additional details on the Alaska Region's efforts to accomplish Steps 1-3 of the I&M Guidelines (as described in the Alaska Region I&M Preproposal) can be found in Wesser (2000).

Acknowledgements

Editorial and scientific review comments were solicited and received from the following individuals: Susan Boudreau (Long Term Ecological Monitoring Coordinator, DENA); Joseph Cook (Curator of Mammals, University of Alaska Museum); Terry DeBruyn (Wildlife Biologist, NPS Alaska Support Office); David Daum (Fishery Biologist, US Fish and Wildlife Service); George Dickison (GIS Team Manager, NPS Alaska Support Office); Nikki Guldager (Biological Technician, YUCH/GAAR); Steve MacDonald (Mammalogist, University of Alaska Museum); Trent McDonald (Statistician, Western EcoSystems Technology, Inc); David F. Murray (Professor of Botany and Curator Emeritus, University of Alaska Museum); Debora Nigro (Wildlife Biologist, YUCH); Karen Oakley (Fish and Wildlife Biologist, USGS-BRD); Patty Rost (Resource Management Chief, YUCH/GAAR); Tom Taube (Fishery Biologist, Alaska Department of Fish and Game), Sara Wesser (NPS Inventory and Monitoring Coordinator, Alaska Region), and David W. Wiswar (Fishery Biologist, USFWS). Their comments were critical to the development of this study plan. Dr. Eric Rexstad (Assistant Professor of Quantitative Wildlife Biology, University of Alaska) was instrumental in developing the small mammal inventory design. The inventory coordinator would also like to thank the principal investigators for their time and effort in developing these project descriptions in addition to their regularly scheduled responsibilities.

NETWORK INVENTORY OVERVIEW

Network Inventory Goals and Objectives

Inventory objectives for the Central Alaska Network were defined at the April 25-27 Inventory Scoping Meeting in Anchorage, AK. During this meeting, resource and management staffs from each park prioritized their inventory needs for the 5 biological taxa (Hanson 2000). These park-based priorities were then combined on a network basis to arrive at the objectives below. Inventory needs were based on known availability of information for each taxa (or subtaxa grouping), identified management information needs, and the number of expected versus present species based on inventory information being compiled by ANHP; current expected species lists are available on the internet at ftp.nps.gov/incoming/akso/i&m and summaries of this data are in Table 1. Inventory work was not proposed for those taxa in which >90% documentation has been achieved.

Table 1. Summary of documented and expected species of vascular plants and vertebrates for each park in the Central Alaska Network. 90% species documentation is the targeted goal for the NPS Servicewide Inventory Program. (Preliminary data from the Alaska Natural Heritage Program, June 2000.)

Park Unit	Vascular Plants			Birds			Mammals			Fishes (Freshwater)			Amphibians		
	# documented	# expected	**% documented**	# documented	# expected	**% documented**	# documented	# expected	**% documented**	# documented	# expected	**% documented**	# documented	# expected	**% documented**
DENA	684	790	**87**	154	184	**84**	37	38	**97**	10	13	**77**	1	1	**100**
WRST	881	1137	**77**	219	244	**90**	38	55	**69**	14	22	**64**	1	3	**33**
YUCH	450	720	**63**	150	167	**90**	25	43	**58**	16	18	**89**	1	2	**50**

The inventory goals for the Central Alaska Network are as follows:

1. *Conduct targeted plant inventories that will result in documentation of the occurrence of 90% of the plant species currently estimated to exist in each park in the Central Alaska Network.*

2. *Conduct small mammal (shrews, microtines and small weasels) inventories that will result in documentation of the occurrence, distribution, and abundance of 90% of these small mammal species currently estimated to exist in each park in the Central Alaska Network.*

3. *Conduct freshwater (including anadromous) fish inventories that will result in documentation of the occurrence and distribution of 90% of the freshwater fish species currently estimated to exist in each park in the Central Alaska Network.*

Qualified principal investigators were available on park staff in the Central Alaska Network to develop detailed project descriptions for each of these goals. Resumes for all principal investigators and key coworkers can be found in Appendix I. The funding level for each inventory project was based on the percentage of points it received through a weighted priority ranking process. Principal investigators determined funding allocations for each network park based on existing information, transportation costs, and management information needs as established during the scoping meetings in April (Hanson 2000). Specific objectives for each of the network goals are addressed in the project descriptions for each inventory project.

Also during the April scoping meetings, more detailed inventory objectives for species of special management concern were identified by park staffs and invited taxa experts; these objectives were based on data gaps, information needs, and management issues. Accomplishment of these more specific objectives is beyond the funding capabilities of this inventory effort and currently requested funds will not be applied to them. The objectives for species of special management concern for the Central Alaska Network are as follows:

1. *Determine the occurrence and distribution of lichens and bryophytes in all three parks in the Central Alaska Network.*

2. *Identify and curate all lichens and bryophytes already collected in all 3 parks.*

3. *Determine the distribution, relative abundance and habitat associations of furbearer species in YUCH.*

4. *Determine the distribution, relative abundance and habitat associations of furbearer species in DENA.*

5. *Determine the occurrence and distribution of amphibians in WRST.*

6. *Determine relative abundance of open landscape birds in DENA.*

7. *Document occurrence, distribution, and abundance for rare and endemic plants in WRST.*

8. *Determine life histories and develop predictive models for select rare and endemic plants in WRST.*

Brief project descriptions for each objective are presented in Appendix II. Descriptions are formatted to be inserted in the NPS Project Management Information System (PMIS) to facilitate securing funding from other sources.

Network Coordination and Logistical Support

Inventory work in the Central Alaska Network is being coordinated by a group consisting of the Resource Management Division Chiefs at each park [Patty Rost (YUCH), Devi Sharp (WRST) and Gordon Olson (DENA)], the park-specific I&M leads [Shelli Swanson (YUCH), Mary Beth Cook (WRST) and Carl Roland (DENA)], and the Alaska Region I&M Coordinator (Sara Wesser). Shelli Swanson also serves as the network coordinator and the representative to the I&M Steering Committee for the Alaska Region. These individuals are involved in all major decisions pertaining to inventory priorities, project development, and program oversight. The network coordinator will serve as the primary oversight person for the network, facilitating coordination between inventory projects and forwarding expected products and reports to the Regional I&M Coordinator in a timely manner. Since all parks/preserves are to receive some level of work on all three identified inventory taxa, they each have a vested interest in seeing that deadlines, reports, and funding transfers occur on schedule.

All principal investigators and the network coordinator are currently park staff; their salaries, office space, and supplies will come from their respective park's base funds. DENA will provide budget assistance for all network projects. Each park/preserve in the Central Alaska Network has assigned a staff member to each inventory project. These representatives will assist principal investigators and field personnel with planning and logistical arrangements at the park level (lodging, communications, field assistance, and schedules). They will also assist with sample site selection to ensure that park management concerns are met. Principal investigators will work with park representatives to make use of existing equipment, modes of transportation, and supplies necessary for their inventory work.

Sampling Designs

Sample designs were developed for each inventory using stratification schemes that would facilitate extrapolation to larger areas and allow for comparisons within and between parks; in some instances, comparisons can be made between Alaskan networks. Ecological sections and subsections are being used as stratification layers for the small mammal and plant inventories.

These stratification units will enable us to maximize species diversity by sampling ecologically different areas and will distribute sampling throughout each park. These nested ecological units are also being used for the small mammal inventory in the Northwest Alaska Network, allowing us to look at regional small mammal distributions. The freshwater fish inventory will be stratified based on watershed, stream order, lake connectivity to streams, and elevation. Both of these stratification approaches can be applied to each park in the network and will provide a systematic means of collecting additional taxa information as funding becomes available in the future.

Selection of random sampling sites will be incorporated into the small mammal and freshwater fish inventories. Sampling will occur on a minimum of 2 sites per strata (ecological sections in the small mammal inventory and the stream/lake strata to be developed for the freshwater fish inventory) to allow extrapolation of sampling results across the entire strata. The random element of these sampling strategies will enable the results to be extrapolated to larger areas from the areas that will be sampled. Targeted sampling has been incorporated into the plant (all sample sites) and freshwater fish (33% of the sample sites) study designs to ensure that sampling occurs in unique sites or habitats where species that are expected but not documented may exist. Targeted sampling is considered a critical means of reaching the 90% documented occurrence goal as set forth by the Servicewide Inventory and Monitoring Program; this is especially true in situations where parks have already completed some inventory work and where access is costly.

These sample designs will ensure that the same level of information is available or collected for each park unit in the network, significantly expanding current knowledge of species occurrence, distribution, and relative abundance. Specific information on proposed sample designs can be found in the project description for each inventory.

Data Management

Our data management activities include collection, handling, archiving, and dissemination phases.

During the collection phase, data management activities will involve building relatedness among data sets for the three inventory projects through standardized field forms, site and event codes, and habitat measures. We will ensure data can be related across inventories and be readily incorporated into our GIS. Each principal investigator will be required to develop databases consistent with this overall design. In addition, each principal investigator is responsible for assuring field activities are well-documented and facilitating accurate implementation of sample methods and collection of complete data. A meeting of the principal investigators in January is planned to coordinate field forms, data measurements, and site/event codes.

During the data handling phase, data management activities focus on: 1) designing tools for data entry that reduce transcription errors; 2) independently verifying data transcription; and 3) developing data error-trapping techniques. Again, each principal investigator is responsible for these tasks.

Archiving and dissemination of the data will be accomplished as follows. The Network Lead will be responsible for incorporating inventory data into the servicewide databases either by ensuring that principal investigators accomplish the task or by including the task in a scope of work. In addition, final reports and manuscripts regarding the inventory will be entered into NRBib and each dataset will be recorded in the Dataset Catalog. Original field data sheets will be stored by the principal investigator, with a copy stored with the network coordinator. A website will be developed by the Alaska Support Office GIS team. Copies of digital data, metadata, reports and summaries will be posted to the website and distributed on CD to the network parks, Regional I&M Coordinator, and Servicewide I&M Coordinator.

All inventories will be required to produce ArcInfo or ArcView datasets compatible with the GIS Theme Manager. Specifications for GIS datasets will be provided to each principal investigator who will be responsible for ensuring the completeness and accuracy of submitted products. The Network Lead will work with the Alaska Support Office GIS Team and the Regional I&M Coordinator to incorporate new GIS and appropriate tabular data into the GIS Theme Manager.

Quality Assurance/Quality Control.--The Network Lead will coordinate quality assurance assessment at the network level. This may be accomplished by annual meetings with park staff, principal investigators, and the Regional I&M Coordinator. Products will be reviewed for completeness and accuracy, and reports will be peer reviewed, prior to submission to the regional office. We will ensure that the inventories are accomplished within the guidelines of the servicewide program by coordinating with the Regional Coordinator and the Alaska Region I&M Steering Committee.

On the project level, principal investigators will be responsible for hiring and training skilled personnel for their specific inventories. Periodic checks on data collection procedures and accuracy will be conducted to ensure data quality and consistency. Changes needed or incorporated in study design, data collection, or methods will be recorded and evaluated annually.

Voucher Specimens

Voucher specimens will be collected during each inventory in accordance with accepted preparation and preservation techniques. Verification of plant and vertebrate species will be obtained from taxa experts. Vouchered specimens will be cataloged in ANCS+ by project technicians and housed in the University of Alaska Museum collections. Specific voucher selection, preparation, processing, and storage information is included in each inventory project description.

Network Inventory Timeline

Plant, small mammal, and freshwater fish inventories will occur in each park unit in the Central Alaska Network. Network inventory projects will rotate between parks according to the schedule outlined in Table 2.

Table 2. Schedule for conducting biological inventory work in the Central Alaska Network by Fiscal Year (FY).

Inventory	FY01	FY02	FY03	FY04
Plants	Denali NP&P	Wrangell-St. Elias NP&P	Yukon-Charley Rivers NP	Data finalization and synthesis for all taxa and park units
Small Mammals	Yukon-Charley Rivers NP	Denali NP&P	Wrangell-St. Elias NP&P	
Freshwater Fish	Wrangell-St. Elias NP&P	Yukon-Charley Rivers NP	Denali NP&P	

Seasonal weather patterns and sample site locations will determine actual inventory timeframes, but for planning purposes, plant inventories will occur from late June-early August, small mammal inventories from mid August-mid September, and freshwater fish inventories from late June - late September. A meeting of all inventory principal investigators is being planned in January 2001 to coordinate summer fieldwork schedules and helicopter use and sharing between inventory projects. Determination of helicopter contract possibilities and lengths, where and when helicopter access is needed, and other access/transportation issues will be coordinated during that meeting. Use of the FIREPRO contract helicopter will be discussed and scheduled when possible.

All progress reports and annual products will be provided to the Network Coordinator (Shelli Swanson) by January 31. These products will be forwarded on to the Regional I&M Coordinator (Sara Wesser), who will incorporate the information into the Alaska Region Inventory Website and pass them on to the WASO office.

Network Budget Summary

Study Plan Component	FY00	FY01	FY02	FY03	FY04	Component Subtotals
Preproposal work to accomplish Steps 1-3 of the Guidelines	130,915					130,915
Plant Inventory		90,316	90,316	90,316	45,052	316,000
Small Mammal Inventory		70,618	71,074	71,374	12,434	225,500
Freshwater Fish Inventory		101,400	72,200	94,400	2500	270,500
Annual Subtotal		262,334	233,590	255,790	60,286	
Grand Total						**$942,915**

All Principal Investigators, the Network Coordinator (YUCH), and the Budget Assistant (DENA) are currently park staff and park base funding will cover their salaries, office spaces, and supplies. Looking at salaries alone over the next 4 years, each park will contribute an annual mean of the following to the Central Network Inventory Program: DENA--$28,535 (10 pay periods GS-11 co-plant principal investigator, 3 pay periods GS-7 budget assistant); WRST--$45,610 (8 pay periods GS-12 freshwater fish principal investigator and 10 pay periods GS-11 plant co-principal investigator); and YUCH--$42,839 (6 pay periods GS-11 mammal principal investigator, 8 pay periods GS-11 network coordinator, 2 pay periods GS-7 biological technician, and 2.5 pay periods GS-12 fishery biologist). In total, over the next 4 years these salary contributions equal 58% of the Servicewide I&M budget allocation for the network.

NETWORK STUDY AREAS

Denali National Park and Preserve

The Alaska Range runs northeast to southwest through DENA and is characterized by mountain peaks >9,850 ft (>3,000 m), glaciers, and glacial valleys. Northeastern DENA is flanked by lower mountains <6,900 ft (<2,100 m) dissected by several major rivers flowing northward; two broad fault valleys run perpendicular to these major drainages. Permafrost is discontinuous on the north side of DENA but very rare south of the Alaska Range. Permanent snow and ice occur above 7,800 ft (2,400 m). Climate on the northern side of the Alaska Range is strongly continental, with long cold winters and short but warm summers. Weather in the region is typical of subarctic montane climate with temperatures ranging from 90º F (32º C) in summer to –52º F (-47º C) in winter. Average annual precipitation at Denali headquarters on the eastern boundary is 14.8 inches (38 cm), including 74 inches (190 cm) of snowfall. Maritime air strongly influences the climate on the south side of the Alaska range, resulting in warmer and wetter winters and generally more cloudy, cooler, and slightly longer summers.

The differences in climate between the north and south sides of the Park result in strong differences in the character of the vegetation and the composition of the flora in the respective areas. Upper mountain slopes and foothills are covered predominantly by alpine sedge (*Carex spp*.) and shrub (*Salix spp.* and *Betula spp*.) tundras. Treeline, though varying with topography and location, occurs at about 800 m with spruce (*Picea spp*.) woodlands/forests, tussock (*Eriophorum spp*.) tundra, and riparian spruce/willow zones below. In the western portion of DENA, the tundra foothills of the Mount McKinley/Foraker massif extend northward into lowland flats with spruce forests, bogs and many north-flowing rivers.

Wrangell-St. Elias National Park and Preserve

A transect through Wrangell-St. Elias National Park and Preserve from its southern boundary on the Gulf of Alaska to its northern border in the Tanana Lowlands traverses over 200 miles through the Chugach, St. Elias, Wrangell and Alaska Mountain systems. The climatic gradient along this transect passes through maritime, transitional and interior climatic zones. Precipitation ranges from a yearly average of 133 inches (338 cm) at Yakutat, located in the maritime climatic zone, to eight inches at Slana in the interior climatic zone. Temperatures on the coast are mild ranging from a mean daily high of 59°F (15°C) to a mean daily low of 15.8°F (-9°C); temperatures in the interior are more extreme ranging from a mean daily high of 68°F (20°C) to a mean daily low of -13°F (-25°C).

The diversity of WRST's landscape and its complex geologic and ecological history are reflected in the composition of its vegetation and flora. Lowland vegetation ranges from the coastal Sitka Spruce (*Picea sitchensis*) forests on the Malaspina Forelands to interior black and white spruce (*Picea mariana* and *P. glauca*) taiga forests with poorly drained soils in the region of old Lake Ahtna in the Copper River Basin. Wetlands are common along the coast and in the interior particularly in the Copper and Chitina River Basins and north of the Alaska Range. River corridors and upland areas with better drainage support more productive forests of white spruce with paper birch (*Betula papyrifera)*, quaking aspen (*Populus tremuloides*), black cottonwood (*P. trichocarpa*) and balsam poplar *(P. balsamifera*). Treeline varies with aspect and local conditions from 3500 to 4500 ft (1067 to 1372 m). The subalpine zone has a high cover of tundra shurbs such as blueberry (*Vaccinium uliginosum*), dwarf birch (*Betula glandulosa*), shrub cinquefoil (*Potentilla fruticosa*) and fewer trees. Alpine vegetation varies depending on whether the site is in a snowbed area, a poorly drained area or a dry site, although dwarf heath shrubs, forbs, sedges and grassess are most common. Dry alpine sites harbor numerous rare and endemic plant species.

Yukon-Charley Rivers National Preserve

Yukon-Charley Rivers National Preserve encompasses 2.5 million acres and is located in the eastern portion of interior Alaska known as the Yukon-Tanana Uplands (Fig. 1). The Yukon River traverses the northern portion of the preserve and the entire Charley River watershed is contained within the preserve boundaries. The terrain rises gradually from the Yukon River to a mountainous area in the southern portion of the preserve where peaks reach 6,560 ft. (2000 m). The mean annual temperature is 42°F (5.6°C), with a July mean of 60°F (15.6°C) and a January mean of -13°F (-25°C).

The upper Yukon River lies within the northern boreal forest biome and is dominated by taiga ecosystems. Open muskegs of black spruce (*Picea mariana*) occupy low-lying terrain and areas underlain by permafrost. Closed white spruce (*P. glauca*) and mixed spruce-birch forest occupies uplands and well-drained sites. Dry and warm south-facing slopes and recently burned sites support aspen woodland (*Populus tremuloides*) and particularly xeric sites on river bluffs have open patches of steppe vegetation. Newly exposed floodplain surfaces support seral herbs and stabilized terraces

are occupied by alder (*Alnus* spp.) and willow (*Salix* spp.) thickets and poplar (*P. balsamifera*) forest, which grade into white spruce forest on older valley floor surfaces. A subalpine zone dominated by birch and willow scrub occurs near the elevational limit of trees. Alpine tundra occurs above about 3,300 ft (1000 m) in elevation, depending on topographic position and local site factors.

PLANT INVENTORY PROJECT DESCRIPTION

Principal Investigators: Carl Roland (DENA) and Mary Beth Cook (WRST)

Problem Statement

The analysis of documented and expected vascular plant species in the Central Alaska Network parks reveal relatively low percentages of documented species (75% for DENA, 77% for WRST and 65% for YUCH). Certain habitats, such as subarctic steppe in YUCH and selected geographic areas, such as the DENA park road corridor and parts of northern WRST, have been the focus of substantial plant inventory work. However, there are considerably more gaps in our knowledge of the flora in the Central Alaska Network parks than there are areas for which we have comprehensive floristic information. Land managers and researchers do not possess information on the composition, diversity and distribution of the flora for the vast majority of the lands within the network. Similarly, there is inadequate information about the distribution of rare, endemic and other plant species of special management concern in the Central Alaska Network. Consequently, there is a distinct need to assemble a comprehensive baseline of floristic inventory information from sites throughout these three diverse park units.

Previous Work

The existing plant collections and floristic inventory data have been comprehensively reviewed and summarized by the principal investigators for both DENA and WRST (Appendix III, Cook 1994, 1995, 1999; Cook and Roland 1996, Cook and Roland in prep., Roland 1998 & 1999). We are currently in the process of compiling this information for YUCH. In addition to compiling previous inventory data, we have assembled and georeferenced all available electronic records of plant specimens and site inventory information for each park (Figures 2- 4), created a relational database structure for storing, tracking and analyzing plant inventory information, and created GIS-based distribution maps for more than 200 plant species that occur in the network. This data framework will allow us to quickly and efficiently integrate, analyze and communicate new plant inventory information.

The existence of working protocols for incorporating and analyzing new floristic information in GIS will greatly benefit the inventory project described in this study plan. In fact, virtually all of the pre-inventory tasks, including the preparation of expected species lists, were completed for DENA and WRST several years ago (Cook 1994, 1995; Cook and Roland in prep., Roland 1998). The Central Alaska Network parks are thus very well prepared to immediately and efficiently begin implementing additional plant inventory fieldwork.

Objectives

1. To document 90% percent of the plants expected to occur in each park unit by surveying targeted sites within unsurveyed regions.

2. To expand current knowledge of the distributions of the plant species that occur in the Central Alaska Network.

3. To describe the taxonomic, ecological and geographic characteristics of selected species of special management concern.

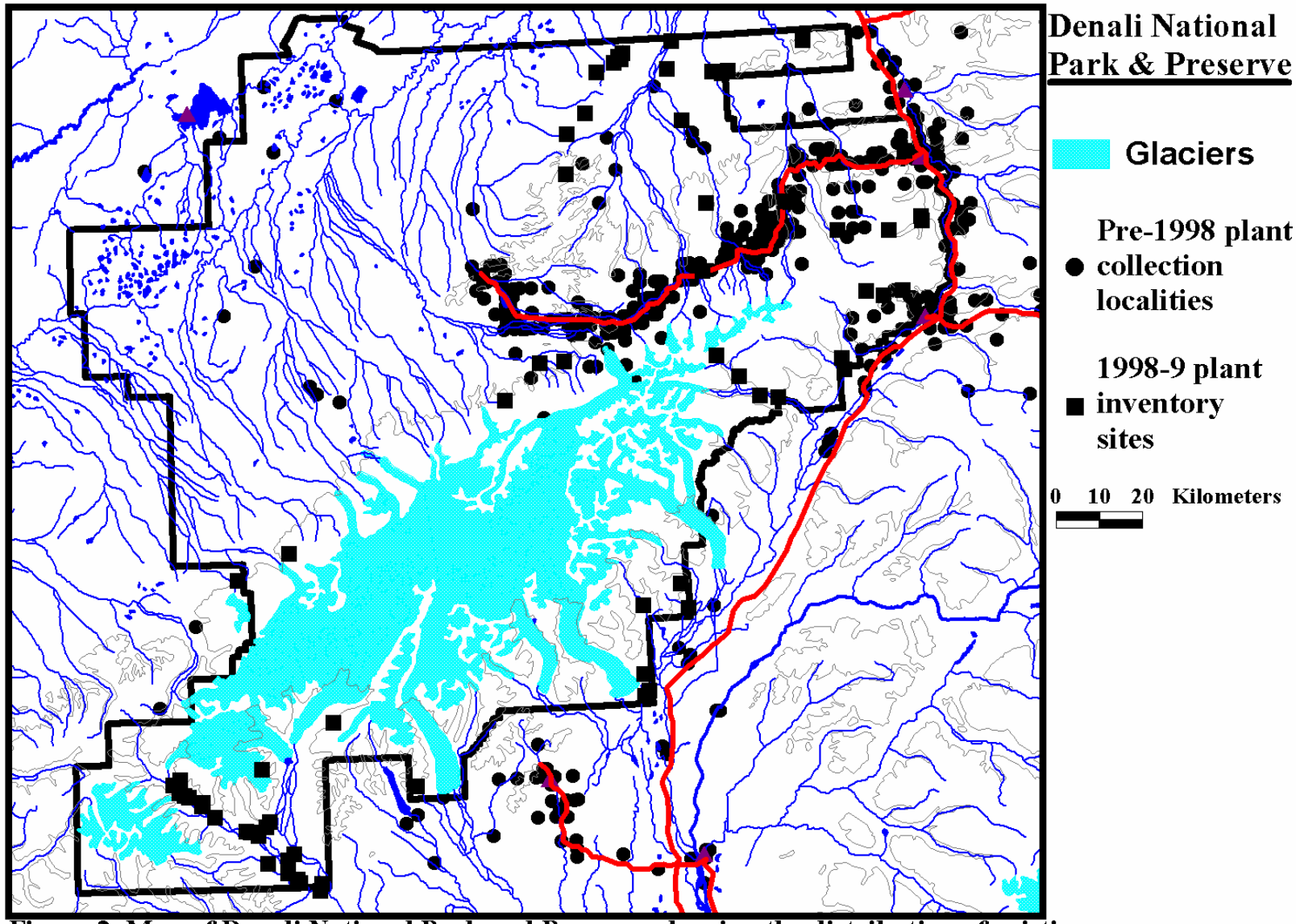

Figure 2. Map of Denali National Park and Preserve showing the distribution of existing plant collection and floristic inventory sites.

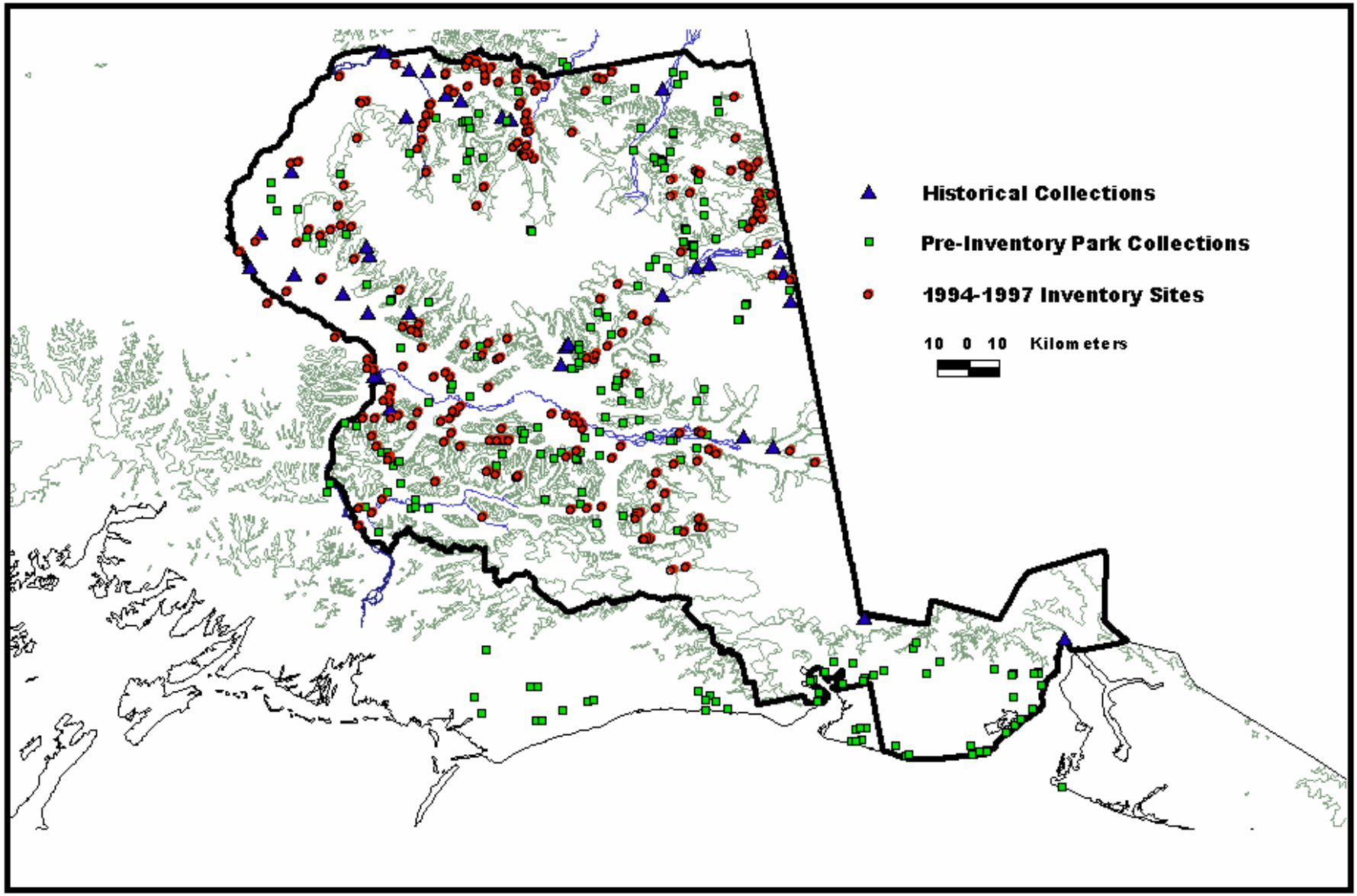

Figure 3. Vascular plant collections and inventory sites within Wrangell-St. Elias National Park and Preserve, Alaska.

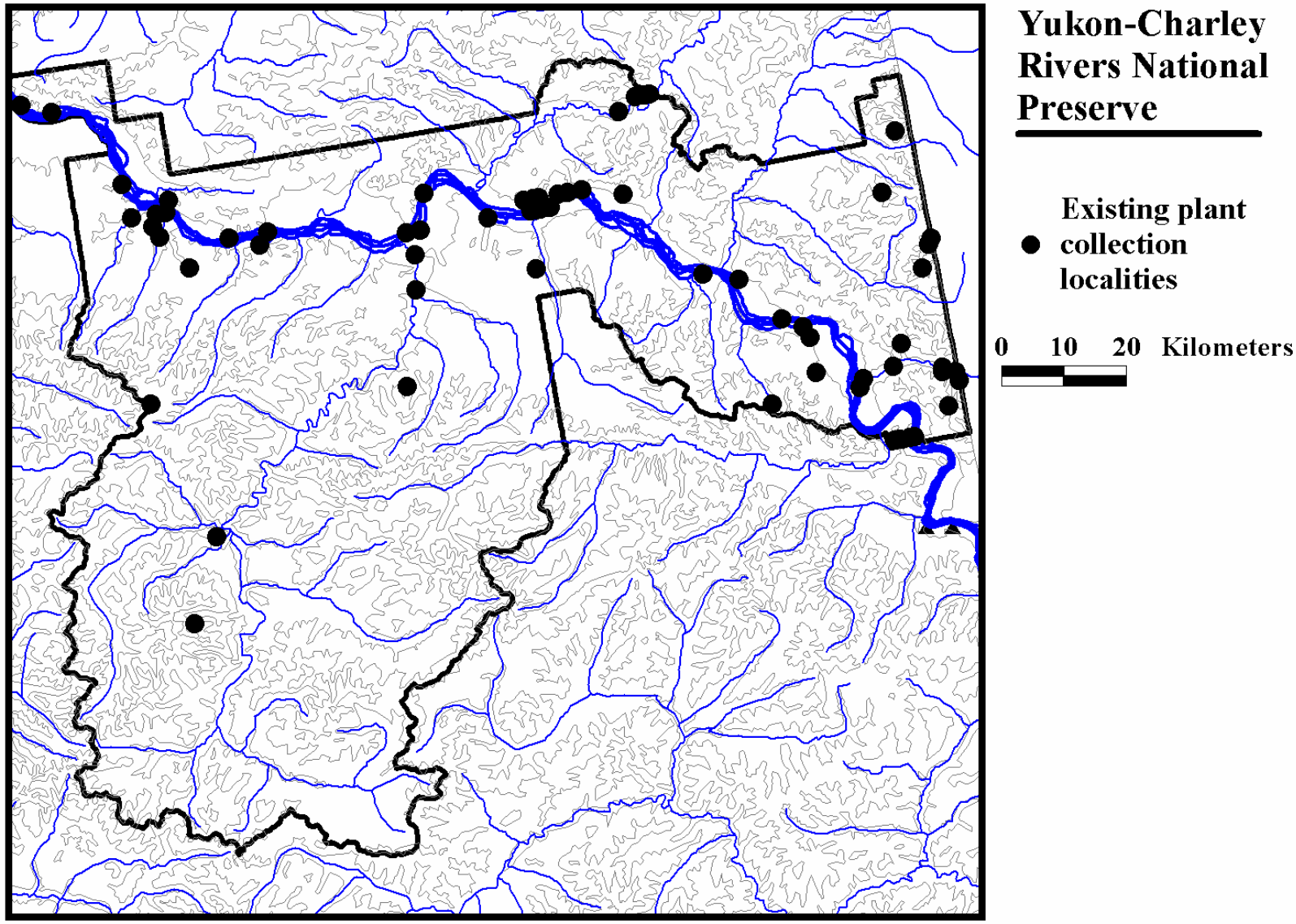

Figure 4. Map of Yukon-Charley Rivers National Preserve showing the majority of existing plant collection localities.

4. To acquire more information about the relative abundance of selected species within the area sampled.

5. To gather a set of voucher specimens of each species present in the network and to populate national and local databases with taxonomic and accompanying data.

6. To acquire new inventory information in a format compatible with ongoing plant inventory efforts in the Central Alaska Network.

Sampling Design

Reconnaissance design--A reconnaissance method was recommended as the best approach for plant inventories in all Alaska parks by the Alaska plant experts [David F. Murray, Alan Batten and Carolyn Parker (University of Alaska Herbarium) and Robert Lipkin (Alaska Natural Heritage Program)] at the inventory scoping meeting held in April 2000 and by the Alaska Plant Inventory Working Group at their September 2000 meeting. This method requires identifying targeted study sites within unsurveyed areas of each Park using key criteria such as:

- regionally unique geological or geomorphological features
- communities or habitats of biological concern
- likely habitats of expected species, as indicated by regional floras (e.g., Hulten 1968) and park collections
- under-represented plant communities in existing inventories
- minimum sample unit allocation to each major ecoregion or to other target landscape strata
- logistical feasibility (e.g., access means, cost)
- potential of certain types of sites to maximize species and communities encountered (e.g., ecotones, high gradient areas)

The goal of this methodology is to maximize the diversity of both plant species and plant community-types encountered during field inventory work. A matrix listing all vascular plant species encountered in each plant community will be compiled for all inventory sites. This method will provide the following data: occurrence of all species within each of the plant communities encountered at each site, general frequency and abundance categories for each species, and trends in the distribution of species with respect to site and community characteristics. A standard community classification will be adopted for this project based on the Viereck level-four Alaska vegetation classification (Viereck et al 1992). A site is defined as each specific geographic location where field inventory work is performed. Sites will vary considerably in their degree of accessibility to surrounding terrain, inherent ecological complexity and overall plant diversity. Therefore varying amounts of time will be required in order to complete the plant inventory protocol in different sites. Field sites will be selected from the targeted study areas through a detailed examination of physical, ecological and biogeographic data as described below. Access to inventory sites will be by foot, boat, fixed wing aircraft, and helicopter. The reconnaissance design provides flexibility in allocating sites so that the maximum financial efficiency can be achieved by using all available forms of access. Fieldwork will begin in DENA in the summer of 2001, followed by WRST in 2002 and YUCH in 2003.

Study area delineation.--The amount of existing plant inventory information is extremely variable within each of the central Alaska Parks. Selected geographic areas and habitats within each unit are well studied, whereas many other areas are essentially unknown floristically (Appendix III, Figures 2-4). In order to correct these imbalances in inventory information, our efforts will be focused in the ecological and geographic “gap” areas. The process for identifying these gaps, a key component of study area delineation and site selection for this study, is described for DENA and WRST in

Appendix IV; study area delineation and prioritization is completed for DENA and WRST and is in progress for YUCH.

To delineate study areas within each park, we will follow these steps:

1. Stratify each Park based on ecoregion subsection-level maps (Clark 1997, Swanson 1999, WRST map in prep.);
2. Identify important geographic gaps in plant inventory within each park by examining the number of collection localities and floristic inventory sites within each stratum;
3. Identify the major ecological gaps in plant inventory data by analyzing the ecological and habitat traits of the pool of expected species for each park;
4. Identify important areas of management concern within under-studied areas; and
5. Prioritize the strata by identifying those subsections that represented both major geographic and habitat gaps in our plant inventory data. The subsections identified through this process will be the primary study areas for plant inventory efforts in the Central Alaska Network.

Site selection.--The final step prior to field work requires the selection of inventory sites from within the targeted study areas. The site selection process for this study requires detailed examination of aerial photographs, soils, geology, and landcover maps. In order to finalize site selections, aerial surveys of selected areas will be conducted. The following criteria will guide the ultimate set of inventory sites selected:

1. maximizing the likelihood of encountering high numbers of park expected taxa and/or species of special management concern per unit access cost;
2. maximizing the overall diversity of plant communities, landcover types, and types of lithology inventoried per unit access cost; and
3. ensuring that all major landscape units (such as floodplains, hill slopes, and wetlands) are surveyed within each area.

Methods

A complete floristic reconnaissance of each site will be completed. All the plant species that are encountered at a site will be recorded and attributed to each of the community types that occur at the site. We have adopted the Viereck level IV vegetation classification as the standard for classifying plant communities (Viereck et al 1992). A critical component of this type of survey is recording *all* species and communities encountered. A second component of the method is recording the amount of time spent in the survey for each site. This floristic examination procedure has been used to document the presence or absence of rare taxa at sites containing numerous plant communities and vegetation types (Goff et al 1982, Nelson 1987). It has been very successful in documenting the occurrence of large numbers of new plant taxa both in Wrangell-St. Elias and Denali National Parks in the recent past (Cook 1994, 1995; Cook and Roland 1996, Cook and Roland, in prep. Roland 1998 and 1999).

On average, we estimate that 2 days will be required per site for an adequate survey for two skilled botanists. Time spent per site will vary greatly depending on access and habitat diversity. A maximum of four sites will be surveyed per day when visiting relatively small or relatively homogeneous sites. Up to six days may be spent inventorying a site that is highly diverse and has terrain that allows for extensive access to surrounding terrain. Due to phenology, it is only possible to perform inventories from the second week of June to the third week of August. We estimate that 60 sites per season per network will be the average given two teams. The following information will be collected according to established protocols:

1. *Site data.* Each site will be mapped on an aerial photo, USGS topographic map and a georeference point will be recorded using GPS. The routes surveyed will be mapped and

georeferenced. A description of the site will be recorded and significant landforms and communities described. An aerial photo of the site and significant communities will be taken on departure.

2. *Community and Vegetation type data.* As the survey is conducted, new communities encountered will be recorded on the community data sheet and a species list compiled by community-type. The following data is recorded on the community data sheet: Viereck vegetation type to level 4 (Viereck et. al. 1992), slope, aspect, elevation, topographic position, wind, moisture, soil types, parent material, cover classes of life forms and bare ground, dominant species by life forms and a general description of the vegetation type.
3. *Species list.* A cumulative species list is compiled as the survey is conducted; complete species lists are completed for each community. A species by community matrix will be constructed for each site.
4. *Vouchers*. Vouchers will be collected and curated as discussed below.
5. *Photo documentation.* Sites will be photographed on the ground and from the air when possible. Communities, notable plants & unique landforms will also be photographed.

Vouchers and Curation

Voucher specimens will be collected for those species that are new to the park or ecoregion, species of concern (rare, endemic, invasive), geographic or ecological range extensions and specimens not identifiable in the field. For selected species, leaf tissue will be collected and held in silica gel for genetic analysis; a complete voucher specimen will accompany all tissue collections. The following data will be collected for each vouchered specimen: date, unique collection number, latitude and longitude (NAD27, decimal degrees); slope, aspect, elevation, topographic position, associated landforms, associated species, Viereck vegetation class, substrate, soil moisture, soil type, drainage, parent material, cover class and frequency class, notes on characters not preserved well, associated photo number, phenology and ecological observations. The size of the population and area surveyed will be included for species of concern.

Collections will be made only if the population is large enough to support removal of individuals and will follow the collecting protocol of Parker and Murray (1992) and Wrangell-St. Elias NP/P standard operating procedures for herbarium collections (Teare 1984). Duplicate collections will be made when possible, one for NPS and one for the University of Alaska Fairbanks Museum Herbarium (ALA). Material will be sent to the University of Alaska Fairbanks Museum (ALA) for storage.

Specimens will be sorted, examined and determined by the botanists who collected them and the collections sent to ALA where notable finds and difficult taxa will be reviewed by the Museum staff. As needed, specimens will be sent out to authorities by ALA for determination. We estimate that 3000 to 5000 specimens will be collected by two teams of botanists in one season in each network.

A cooperative agreement has been initiated with ALA for curation. We anticipate each network contributing to this agreement annually in proportion to the number of specimens that will need to be curated. Specimens to be stored at ALA and those to go to park herbariums will be prepared at ALA.

Data from collections will be imported into ALA's database, and specimen labels will be prepared. This will be the responsibility of the data manager at ALA, Alan Batten. Specimens will be mounted and prepared for storage by the staff at ALA. Duplicates will be sent to the park units. Silica gel and tissue samples will also be curated and stored at ALA for future analysis.

At the park level, specimens will be curated through the import of data into ANCS+. Specimens returned to parks from ALA will need to be filed and accessioned. In addition, catalog ledgers will be updated and loan forms completed. All slides will be labeled, sorted, filed by site and species, and scanned for use in the regional data viewer product. Survey routes will be digitized from aerial

photos and maps. At the end of the project, data sheets, field notes, maps, slides and all associated project files will be accessioned by park and items cataloged.

Data Management

The principal investigators have designed a set of relational databases that integrate site, specimen and taxon based data for plant inventory studies. These databases have been in use and constantly updated since 1995, and will serve as the primary data entry databases for the project. The considerable investment of time and planning represented by these databases will pay substantial dividends to this project. For example, the time required for data entry will be greatly reduced and quality control will be assured because all taxonomic information for each species is automatically entered into the specimen database through entry of a short species code, which is linked to a taxon database where quality-controlled taxonomic data is stored. Similarly, data entry and quality control of site-specific information are simplified through the entry of site number code in the specimen database that is linked to all pertinent site data in a separate quality-controlled site database. This relational database structure drastically reduces the number of records that need to be edited in order to guarantee that accurate site and taxonomic data are stored. Furthermore, entry and quality verification of taxonomic data for all documented plant species in DENA and WRST, and a large majority of the expected species for the network as a whole has already been accomplished.

This set of databases has been successfully used to store and transfer inventory data and prepare specimen labels for the more than six thousand plant specimens that have been collected in ongoing plant inventory efforts in DENA and WRST. These databases have also been used to analyze and summarize floristic data collected during these studies and to export spatial data to GIS for publications and public presentations. We have prepared statewide distribution maps for more than 200 taxa that occur in CAN network Parks using this data management system. In addition, cooperative work with the University of Alaska Museum has allowed us to assemble all statewide records for numerous species of special management concern in the CAN parks. These statewide records are stored in a linked set of databases with identical field definitions and codes to our own collection databases.

We have established protocols and procedures that allow for the ready exchange of data between our databases and those of the University of Alaska Museum, the Alaska Natural Heritage Program and the ANCS+ curation database. In addition, specimen locality data is readily exportable into the Park's GIS for the creation of geospatial products. NPSpecies will be populated from the data entered into these databases. The Alaska Plant Inventory Working Group will meet in Spring of 2001 to standardize and communicate data entry and transfer protocols among networks in the Alaska region.

Site, community, species and collection data will be entered into databases in order to summarize species distributions and abundances, the floristic analyses, rare plant documentation, curation and geospatial products (see below). We have developed field forms for species lists, community, and site data that mirror the fields in the plant inventory relational database structure. We will digitize the distribution of notable species from known references and ALA data so that distribution maps can be prepared. Rare plant sighting forms with maps will be completed for species with an AKNHP state rank <=3 and provided to AKNHP. Data fields will be imported into ANCS+ for NPS curation and into ALA's database for label preparation. NPSpecies will be populated.

A large number of species-specific attributes including life form, biogeographic affinity, geographic range extent information, and taxonomic status have been entered into the taxon database for a majority of the existing documented plant species in the CAN parks. This data bank will expedite completion of several of the data analysis tasks outlined below.

Data Analysis

Data analysis for this project will synthesize all existing collection-based floristic data for each park unit; it will **not** be limited to data that is collected during fieldwork for this project.

Floristics.-- The composition of the flora of each Park will be described by the relative abundance of species in the following classes: life forms (i.e. tree, shrub, forb etc..), plant families and genera, and biogeographic affinity (i.e. circumpolar, North American, Alaska endemic, etc…). The major floristic divisions within the study areas will be delineated and comparisons made among the rare, endemic and exotic floras of each park unit as well as among Alaska Region parks as a whole. Particular attention will be given to describing the distribution and habitat preferences of species of concern such as rare and endemic plants and exotics, and how these overlap. We will create a rare plant list for each park that will be useful for managers and compliance personnel.

Distribution.— We will use new and existing data to delineate and examine the distributions of plant species (particularly rare and endemic taxa) and prepare descriptions of the notable trends and biogeographic patterns that emerge from this inventory work. We expect that this inventory will produce numerous significant range extensions for vascular plant taxa that will advance our knowledge of Alaska's plant geography and stimulate additional studies concerning the biogeography of individual taxa and the distribution of biodiversity in Alaska. As a part of our analysis of plant distributions, we will prepare distribution maps for biogeographically notable species and species of special management concern in each of the three CAN parks. The database and GIS "infrastructure" for the preparation of these maps is in place and will substantially reduce the amount of work required to produce maps for additional taxa. Through a joint consideration of geographic distribution and observed ecological preferences of species of special management concern, polygons of potential habitat will be delimited for selected species within each park unit.

Relative abundance.-- A species by community matrix will be prepared for each inventory site. These matrices will allow for analyses of the distribution of plant diversity among communities, landscape units and ultimately, ecoregions. This will allow us to make general statements about the relative abundance of selected individual species, about where these species tend to occur on the landscape, and to describe their common habitat associations. It should be noted that these relative abundance statements will not be based on strict probabilistic models, because our site selection will be nonrandom. However, we believe that used with sufficient care and the appropriate set of assumptions, these data will allow us to categorize the members of our flora into general abundance/distribution classes ranging from abundant on a network-wide basis, to rare and restricted within an individual Park.

Project Timeline

November 2000 – May 2001:
Final site selection for DENA plant inventory field work, hire project personnel, procure equipment and supplies for project and perform logistical planning for summer 2001 fieldwork. Work on summary of past work for YUCH.

June – August 2001:
DENA plant inventory fieldwork. See Table 3 below for detailed park plan.

Table 3. Timeline and focal areas for inventory work in DENA during 2001.

Time period	Inventory areas	Mode of access	Base
June 11-22	Early phenology sites in the Toklat basin & Teklanika Mountains	Helicopter (FirePro)	Park headquarters
June 25 July 2	Raft access to sites along Toklat River and vicinity (Toklat Basin / Kantishna Hills)	Raft	Remote
July 9 – July 20	Kuskokwim ecoregion sites and selected Alaska Range areas in far SW corner of Park	Helicopter (contracted for Inventory)	Grand View Lodge
July 23 – July 28	Areas on south side of the Alaska Range in conjunction with Soils Inventory project	Helicopter	Talkeetna
July 30 – August 14	Sites in the Minchumina Basin and Kuskokwim lowlands (mostly wetland/aquatic)	Helicopter (contracted for Inventory)	Lake Minchumina and Kantishna
August 14-August 28	Additional sites on south side of the Alaska Range in conjunction with Soils Inventory	Helicopter	Talkeetna

September 2001 – January 2002:
DENA specimen identification, specimen preparation, mounting, and curation, data entry, slide labeling, survey route digitization, complete AKNHP rare plant sighting forms, complete project documentation. Begin NPSpecies data entry, project curation, ANCS+ data import and NPS specimen curation. Prepare site descriptions and annual report covering results of 2001 fieldwork.

January 2002 – May 2002:
Perform final site selection for WRST and logistical planning for summer 2001 fieldwork.

June – August 2002:
WRST plant inventory fieldwork

September 2003 – February 2004:
WRST specimen identification, specimen preparation, mounting, and curation, data entry, slide labeling, survey route digitization, complete AKNHP rare plant sighting forms, complete project documentation. Continue NPSpecies data entry, project curation, ANCS+ data import and NPS specimen curation. Prepare site descriptions and annual report covering results of 2001 fieldwork.

February 2004 – May 2004:
Perform final site selection for YUCH and logistical planning for summer 2001 fieldwork.

June – August 2003:
YUCH plant inventory fieldwork

September 2003 – September 2004:
YUCH specimen identification, specimen preparation, mounting, and curation, data entry, slide labeling, survey route digitization, complete AKNHP rare plant sighting forms, complete project documentation. Prepare site descriptions and annual report covering results of 2001 fieldwork.

NPSpecies data entry, project curation, ANCS+ data import and NPS specimen curation, floristic analyses, regional products completed, reports and publications written.

Park Contributions, Coordination, and Logistical Support

DENA and WRST are contributing 4-5 months (intermittent) of their plant ecologist and botanist's time annually to serve as principal investigators. DENA will be providing the administrative support to manage the budget for the entire network inventory. DENA, WRST, and YUCH will be contributing biological technician assistance for fieldwork, project documentation and curation. The Central Alaska Network principal investigators (from DENA and WRST) will be supervising the completion of the Alaska regional products (data viewers and distribution maps).

The Denali plant inventory fieldwork will be coordinated with an ongoing Soils Inventory and Ecological Site Assessment project as well as other NPS taxon inventory efforts. The WRST coastal survey will be coordinated between the three inventories using the same OAS support and field camps. Surveys of nunataks may be coordinated with an NPS archeological survey and a small mammal inventory by David Hiks of the University of British Columbia, Alberta.

Products

Network products:

1. A complete set of prepared, mounted and curated voucher specimens for each park unit, with full set of duplicates housed at the ALA research herbarium.
2. Fully populated NPSpecies, and ANCS+ databases for each park unit
3. Compilation of a set of local floristic databases that include biogeographic affinity, habitat-preferences, local conservation status and related data for the flora of the Central Alaska Network
4. An annotated species list describing all taxa and the basic geographic and habitat attributes of each for each park unit.
5. Preparation of park level rare plant species lists for each unit
6. Publications in peer-reviewed literature documenting notable results of plant inventory work in the network
7. Annual reports describing the results of inventory in each park unit
8. Final report documenting the survey with results described under the methods section.
9. Floristic analyses describing the composition and biogeographic relationships of the flora of each park unit
10. Comparisons of the composition of the rare and endemic floras both within and among Central Alaska Parks
11. Preparation of maps indicating floristic provinces within the Central Alaska Network and the individual parks (as was done for northern section of WRST).
12. Repository of DNA material of species of concern for use in clarifying conservation issues and taxonomic relationships

Regional products:

1. A GIS-based site data viewer to retrieve inventory locality by geographic location that can be queried by taxon, community type, park unit and ecoregion and that will allow the user to view site photos, species lists and related data.
2. A GIS-based species data viewer that integrates information about a selected group of species of concern for the Alaska Region. This would integrate information on distribution, ecology, and relative abundance of selected taxa with images and descriptive text in an interactive format.
3. Publication-quality distribution maps will be prepared for selected species such as species of concern or major range extensions that result from this project.

Budget for Central Alaska Network Plant Inventory Project

Item	FY01	FY02	FY03	FY04	Subtotals	Notes
Field Work						
Personnel						
Botanist 1	20,352	20,352	20,352			AKNHP contract or NPS GS9 (6 -months)
Botanist 2	13,114	13,114	13,114			ALA: Allen Batten
VIP (travel + stipend)	4,000	4,000	4,000			Bruce Bennett, Dr. David F. Murray
Personnel Subtotal:					**112,398**	
OAS	40,000	40,000	40,000		**120,000**	Helicopter & fixed wing
Travel						
Per diem	3,600	3,600	3,600			60 days x 3 personnel x $20/day backcountry rate
Lodging	400	400	400			
Travel Subtotal:					**12,000**	
Field Equipment and Supplies	1500	1500	1500		**4,500**	Dry suits for aquatic sampling, film and development, field supplies
Post Fieldwork						
Project documentation	1,350	1,350	1,350			GS5 1 pp
NPSpecies Data Entry				3,392		GS9 2 pp
ALA Curation	6,000	6,000	6,000			
ANCS+ Data Import				4,292		GS9 2 pp
Project curation				5,400		GS5 4 pp
Regional Products				13,568		GS9 8 pp
Publications				17,500		Distribution maps (regional product) and network publications and reports
Materials				900		Curation materials and supplies for data viewers
Post Inventory Subtotal:					**67,102**	
Annual Totals:	**90,316**	**90,316**	**90,316**	**45,052**		
Total Budget Request for Plant Inventory Project					**316,000**	

ALA – University of Alaska Fairbanks Herbarium
AKNHP – Alaska Natural Heritage Program

SMALL MAMMAL INVENTORY PROJECT DESCRIPTION

Principal Investigator: John Burch (YUCH)

Problem Statement

Within Alaska, information on the occurrence, distribution, and abundance of large mammalian species (moose, caribou, Dall's sheep, wolves, grizzly bears, black bears, etc.) far exceeds that of small mammal species (shrews, voles, mice, weasels, squirrels, bats, etc.). At the April 2000 scoping meeting for biological inventories in Alaska parks (Hanson 2000), participants determined that knowledge of the occurrence of these small mammal species was fragmentary or completely absent from most park units. Because these species are ecologically important, acquiring basic information about their occurrence, distribution and abundance was given high priority by management and biological staff. Both YUCH and WRST identified small mammal inventories as their highest priority at the scoping meeting.

Review of the number of mammal species expected to occur in each park unit within the Central Alaska Network reveals that 58%, 69%, and 97% of the expected mammalian species have been documented in YUCH, WRST, and DENA respectively. Most of these undocumented species are small mammals. For shrews, small weasels, and rodents in the Muridae and Dipodidae families, vouchered specimens are known for 47% of the expected species in YUCH and 78% of the expected species in WRST and DENA (Table 4). In addition, small mammal inventory efforts have the potential of adding 3 species in YUCH and 7 species in WRST (Table 4).

Previous Work

Most of the previous mammal work in the Central Alaska Network does not focus on small mammals and there have been no comprehensive reports or publications specific to small mammal work in the 3 park units. Small mammal species were collected in the Fourth of July Creek area of YUCH during a marten study and are housed in the University of Alaska Museum (Shults et al. 1993). Britten and McIntyre (Coal Creek vicinity; 1986) and Clough (parkwide mammal list; 1976) also have documented small mammal species occurrence in YUCH. Some small mammal voucher species from WRST and vicinity are housed at the University of Alaska Museum (University of Alaska Museum 2000), and MacDonald (1979) collected small mammal specimens from WRST near Chisana, AK. Provincial lists and observations of small mammal species also are available for WRST and nearby Kluane National Park in Canada (Banfield 1960, Krebs and Wingate 1976, and Mitchell 1998). The most current small mammal information for DENA comes from the small mammal component of the DENA Long Term Ecological Monitoring Program; since the early 1990s, small mammals have been studied along the park road and in the Rock Creek Drainage by Dr. Eric Rexstad and students from the University of Alaska. Several mammal lists produced for DENA contain small mammal species: Dixon (1938), Lachelt (1953), Viereck (1959), Manville and Murie (1962), Young (1965), and Donnell (1984).

Objectives

1) Document the occurrence and abundance of small mammal species (shrews, small weasels, and rodents in the Muridae and Dipodidae families) within the Central Alaska Network;

2) Collect voucher specimens of each captured species in accordance with University of Alaska Museum (UAM) Mammal Collection Standards for accessioning within the UAM system for both research and NPS uses;

Table 4. Occurrence of small mammals by park in the Central Alaska Network. Key: KEY: ● = Species present and vouchered with specimens; ○ = species reported present or probably present but not vouchered; ? = species might possibly occur. (*Primary source: Alaska Natural Heritage Program checklists to NPS, 31 May 2000; compiled by S. O. MacDonald, UAM, 18 Oct. 2000.)*

PARK/PRESERVE	SMALL MAMMALS																								
	SHREWS						WEASELS		RODENTS																
	Sorex cinereus	*S. hoyi*	*S. monticolus*	*S. palustris*	*S. tundrensis*	*S. yukonicus*	*Mustela erminea*	*Mustela nivalis*	*Zapus hudsonius*	*Clethrionomys rutilus*	*Dicrostonyx groenlandicus*	*Lemmus trimucronatus*	*Microtus longicaudus*	*M. miurus*	*M. oeconomus*	*M. pennsylvanicus*	*M. xanthognathus*	*Mus musculus*	*Neotoma cinerea*	*Ondatra zibethicus*	*P. maniculatus*	*Phenacomys intermedius*	*Rattus norvegicus*	*Synaptomys borealis*
DENA	●	●	●	○	●	?	●	●	○	●		○		●	●	●	○			●					●
WRST	●	○	●	○	○	?	●	○	●	●		●	●	●	●	●	?	?	?	●	?	?	?		●
YUCH	○	●	○	○	○	?	○	●	●	●	?	○	○	●	●	●	○			●	?				●

3) Opportunistically collect voucher specimens of other species of small mammals (bats, marmots, squirrels, hares, and pikas) that are listed as “expected but not documented” on the compiled expected species lists;

4) Examine associations between small mammal species distribution, abundance, and habitat characteristics; and

5) Design a small mammal sampling scheme that will allow inferences about small mammals in unsampled areas to be made.

Sampling Design

The study design and field methods for this inventory were developed in conjunction with Eric Rexstad (University of Alaska Fairbanks) who is also the principal investigator for the small mammal inventory in the Northwest Alaska Network. Small mammals will be inventoried in YUCH in 2001, DENA in 2002, and WRST in 2003.

Selection of sampling sites will be done randomly employing a stratified sampling strategy. The stratification criterion will be ecological sections (Figures 5-7; Cleland et. al. 1997) and subsections (Clark 1997, Swanson 1999). These strata levels (based on geology, landforms, soils, vegetation, etc.) are tiered; multiple subsections comprise each section. Strata will be further refined by excluding from sampling those areas above 1500 meters or covered by glaciers.

Proportional allocation sampling will be used to distribute the sampling sites among the ecological section strata. However, a minimum of 2 sites per ecological section unit will need to be sampled to assess variability and allow for data extrapolation over the unit. Selection of sampling site placement within each stratum will be conducted by employing a constrained randomization design to ensure that no subsection receives more than one sampling site. This attempts to maximize our ability to sample heterogeneity within ecological sections with a minimum of replicates.

Topographic maps and prior knowledge of the area from park staff will be used to evaluate the feasibility of small mammal trapping from the randomly selected sites. Given the instance where a site is unsuitable (i.e. steep, rugged, inaccessible), the closest accessible site within a 1 km radius will be selected. If there are no favorable sites within 1 km, that site will be abandoned and the next alternative site will be selected. Questionable sites may be evaluated with a fixed-wing overflight, which may be incorporated into other park projects such as aerial radio telemetry or law enforcement patrols.

In addition, collaboration with concurrent UAM small mammal inventory efforts in the Central Alaska Network is also being explored. UAM and its Beringian Coeveolution Project (see http://arctos.museum.uaf.edu:8080/projects/bcp/index.html) would like to work with the NPS

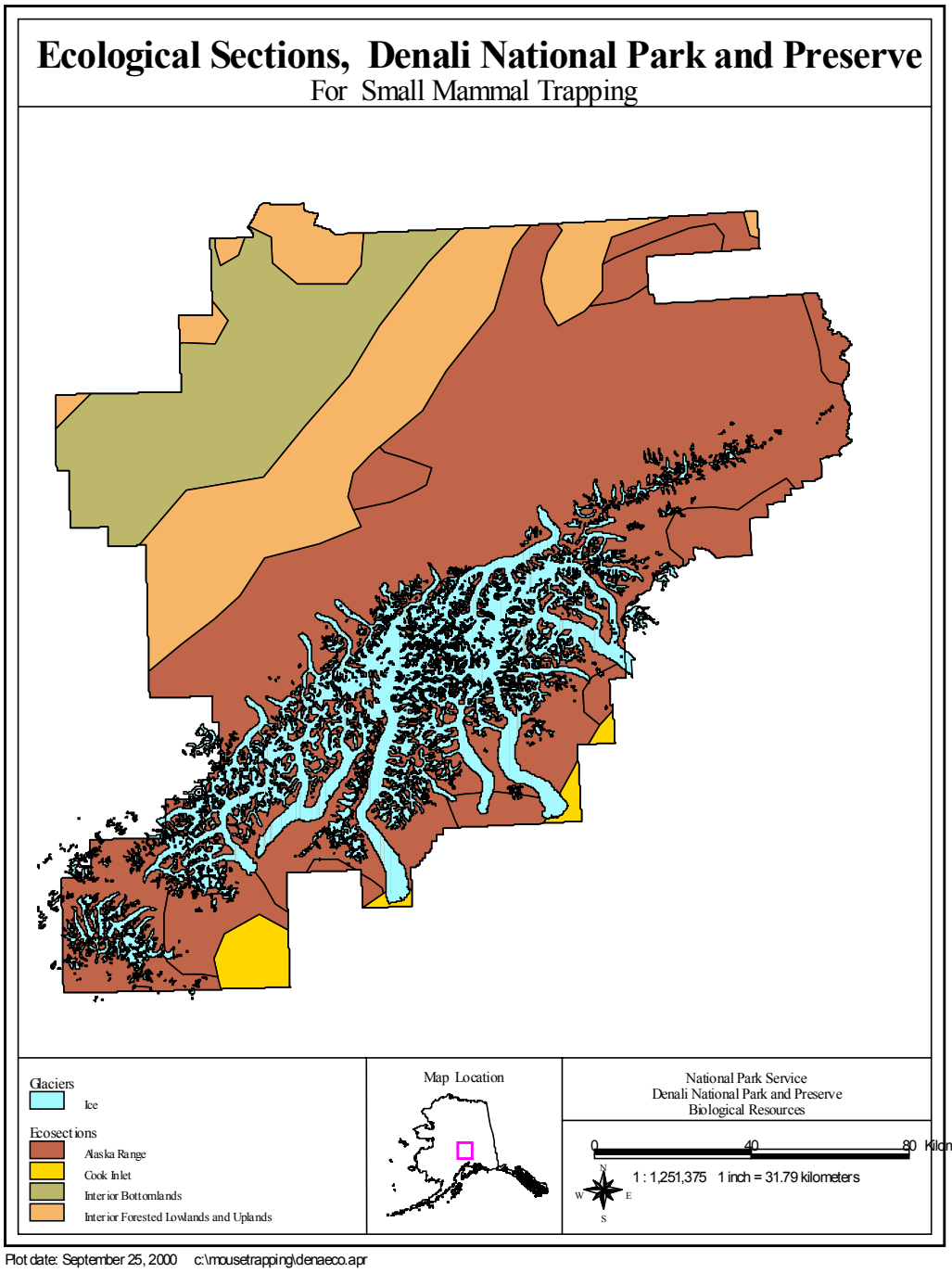

Figure 5. Ecological sections in Denali National Park and Preserve, Alaska.

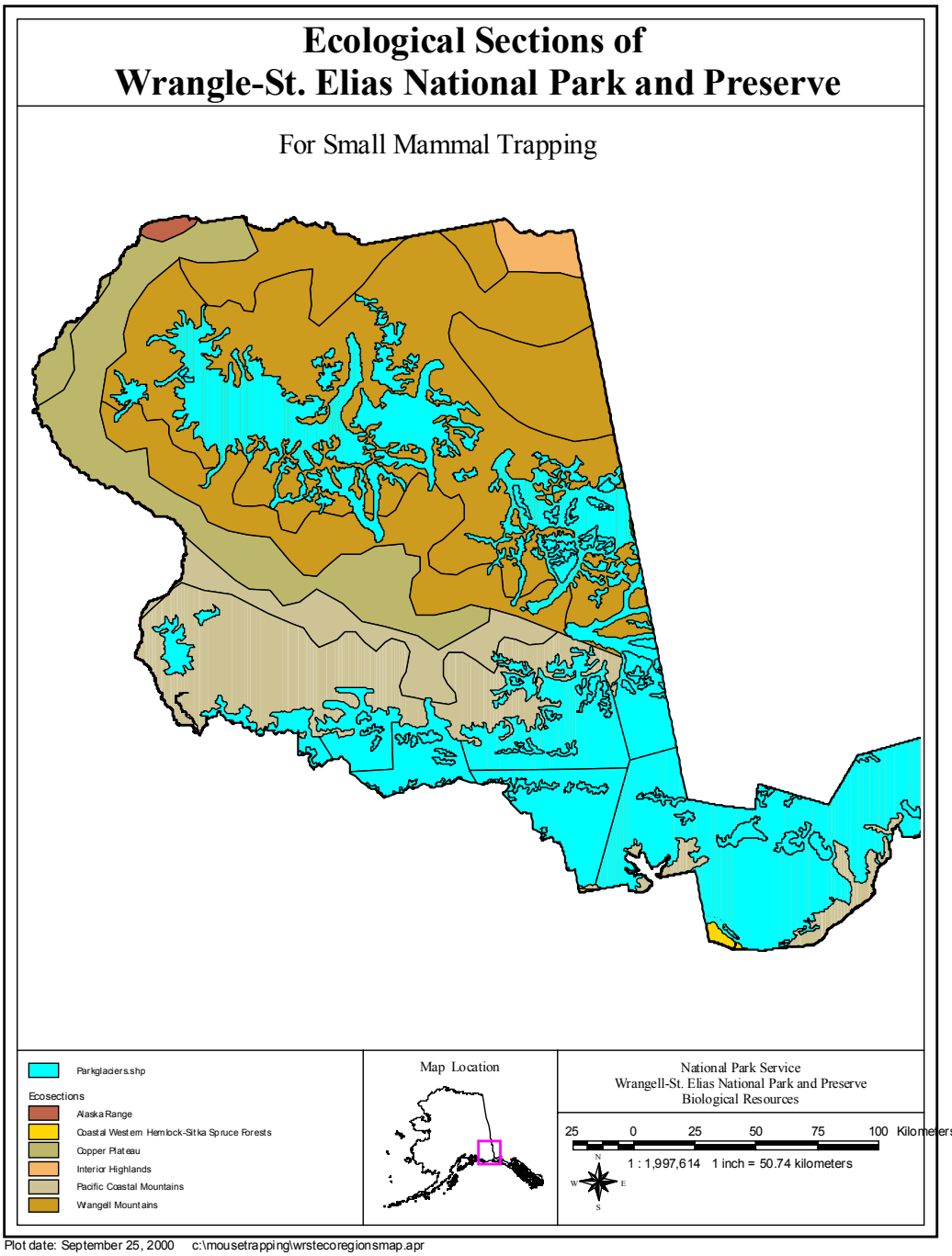

Figure 6. Ecological sections in Wrangell-St. Elias National Park and Preserve, Alaska.

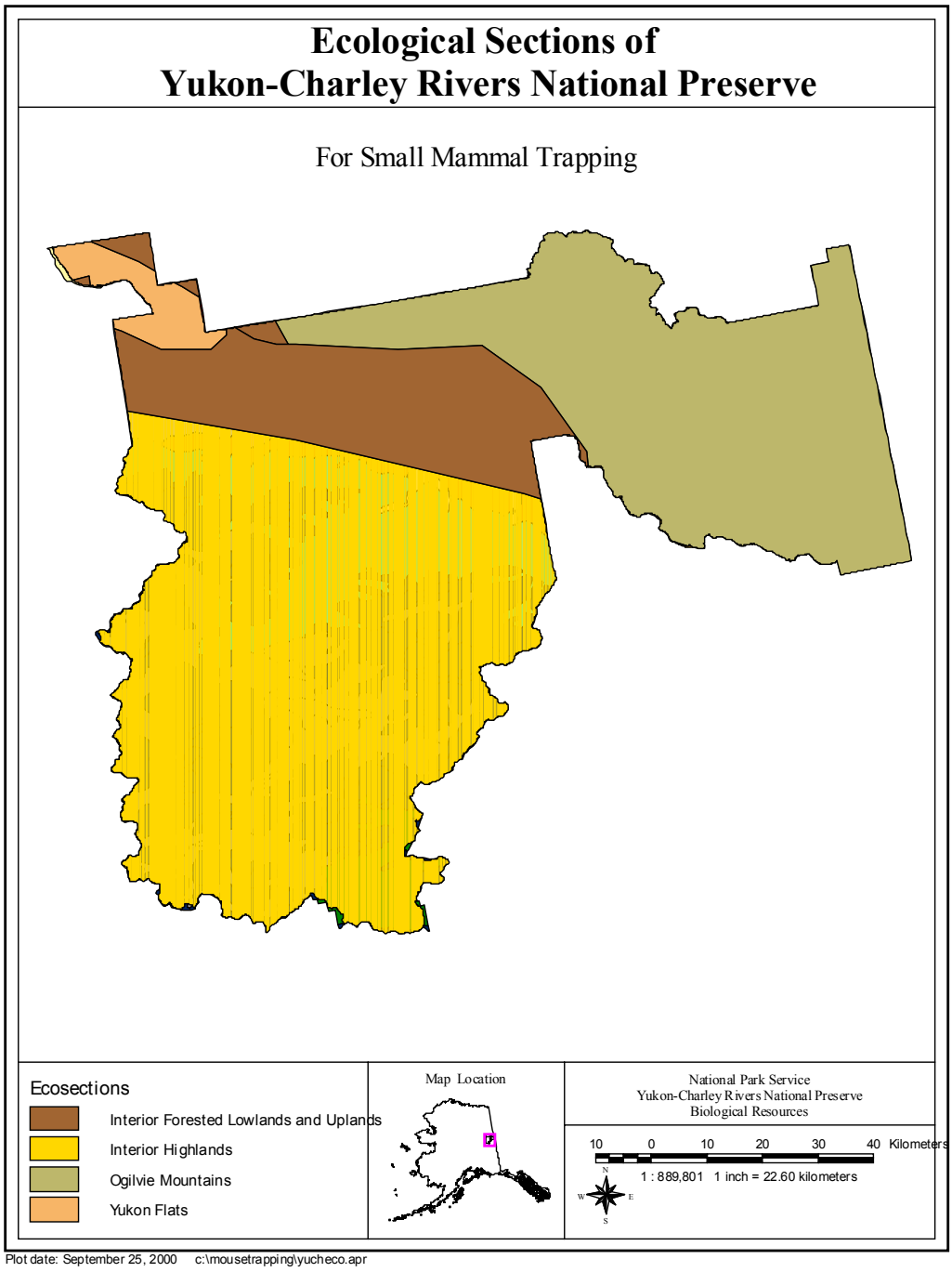

Figure 7. Ecological sections for Yukon-Charley Rivers National Preserve, Alaska.

inventory project to conduct targeted surveys throughout the NPS networks to document the occurrence, relative abundance, and general habitat affinities of each unit's small mammal fauna. Cooperative efforts with UAM would utilize targeted sampling and belt transects (Wilson et al. 1996). By participating in this effort, NPS would be able to utilize skilled UAM personnel and contribute data to several concurrent genetic, contaminant, and parasitology studies. Details on this aspect of the inventory effort will be formalized at a joint UAM/NPS meeting in January 2001.

Methods

Small mammal trapping will be conducted from early August through mid September when small mammal populations are highest and the probabilities for detecting rare species are greatest. Sites will be selected using a stratified random design as explained above. Given funding limitations, only 6-8 trapping sites can be sampled in each park. Consequently, the principal investigator will work with park resource management staff to ensure that ecological units/areas of particular management concern are identified and sampled during the project. YUCH has submitted a proposal to obtain base budget funding to increase the number of sample sites in the preserve in 2001; this funding would augment that obtained through the I&M funding.

Removal trapping techniques employing museum special snap traps, funnel pit fall traps, and conibear traps will be used. The first 2 trap types target voles and shrews and the latter type targets weasels. Traps will be set in 2 configurations: a 100 x 100m grid of trap stations (to estimate species abundance) and 2 trap loops (to sample species diversity). The grid will consist of 100 stations set 10 meters apart. Each station will have 3 traps (2 museum specials and 1 pitfall). A total of 300 traps will be set for the grid. The grid will be placed close to camp and checked twice daily, as recommended for removal trapping (Dr. Eric Rexstad, University of Alaska, personal communication).

Trap loops will be established to sample all available habitat types in the vicinity of camp. Approximately 75 trap stations will be established per loop. Three traps (2 museum specials and 1 pitfall) will be set at each station. Thirty 110 conibear traps for weasels will be placed between stations on each line; traps will be between stations to prevent shrews and voles from avoiding a station due to weasel odors. A total of 510 traps will be set for both loops. GPS locations and flagging will be used to relocate trap sites. Traps will be checked once per day on the loops. Trapping loops will facilitate targeted sampling in different habitats in the grid vicinity and increase our ability to document the species diversity within the ecological subsection and section.

Crews of 3 people will visit each study site for 7 days. A typical trapping schedule for each study site will be as follows:

- Day 1: Travel to study site, setup camp, prepare equipment
- Day 2: Set out and open all traps
- Day 3: Check traps from 1st night, put up specimens, data entry & cataloging. Recheck grid traps in evening and process specimens.
- Day 4: Check traps from 2nd night, begin habitat data collection, put up specimens, data entry & cataloging. Recheck grid traps in evening and process specimens.
- Day 5: Check traps from 3rd night, habitat data collection, pull all loop traps, put up specimens, data entry & cataloging. Recheck grid traps in evening and process specimens. Pull grid traps.
- Day 6: Flex Day, finish habitat data collection use if all traps did not get out on day 2 or something else went wrong, finish up specimens, repair traps.
- Day 7: Day off

Bats, marmots, squirrels, hares, and pikas that are noted on the expected species lists as "expected but not documented" may be collected opportunistically with the appropriate trap set, mist net, or firearm.

Habitat areas where “expected but not documented” species of small mammals listed in Objective 1 will be targeted for trapping as time, transportation, and personnel permit. Expertise of UAM staff will be utilized to successfully carry out these off-transect methods.

Species, mass, sex, age, molt, and reproductive condition will be recorded for each capture (see trapline datasheet in Appendix V). Specific specimen data (total length x tail length x hindfoot length x ear length x weight) will be recorded on pre-numbered UAM museum catalog pages (Appendix V).

Habitat information will be collected for each grid to enable classification to level III of Viereck’s Alaska Vegetation Classification (Viereck et al. 1992). Soil active layer depth and an evaluation of soil moisture will be recorded on each grid and at each trap site on the trapping loops. Landcover type, ecological subsection, slope, aspect, and elevation will be also recorded or determined from GIS coverages upon return from the field. Site-specific habitat characteristics (such as major species and % cover of tree, shrub, forb, and moss categories) will be measured at each trap station on the trapping loops.

Methods for transporting crews and associated equipment and gear to study sites will be evaluated on a site by site basis in order to choose the most economical and least obtrusive access method. Travel to most of the sites will require the use of a helicopter. Other potential access vehicles include raft, motor boat, highway vehicle, and fixed-wing aircraft. Hiking to study sites will be limited because of the amount of food, gear, equipment and traps that need to be transported to each site. Camps will utilize minimum impact camping techniques and adhere to individual park policies on bear proof food storage containers and safety checks. Specimens will also be treated as possible bear attractants and suspended from trees or stored in bear proof containers when possible.

Voucher Specimens

All captured specimens will be collected for vouchering. Animal care and use standards established by University of Alaska Fairbanks will be adhered to by utilizing halothane contaminated cotton balls in a closed plastic jar to euthanize any live specimens. Heart, liver, kidney and muscle tissue will be frozen in liquid nitrogen for each animal captured, and will be archived at the University of Alaska Fairbanks Museum (UAM) for future genetic studies. Study skins and skeletons of all species (not to exceed 20 skins per species) will be made in the field for as many specimens as time allows. Additional specimens will be labeled and placed in large plastic Nalgene ethanol carboys. All specimens will be sent to UAF for final species identification and permanent storage. Curation cost per specimen (including 25% UAM overhead) is $10.00.

Data Management

All crewmembers will be trained in small mammal trapping techniques, identification, specimen preparation, habitat measurements, basic plant identification, and data recording procedures. Assistance from UAM will be requested to ensure training techniques reflect museum standards and data needs. Specimen identification will be verified at UAM by trained mammal collections personnel.

Data will be recorded on waterproof paper datasheets (Appendix V). Detailed field notes will be kept by all field staff and retained as part of the permanent archival information for the project. Field maps of grid and loop locations will also be archived. If possible, all data will be entered into an Access compatible database in the field otherwise, data will be entered by biological technicians upon return to the office. All data will be proofed from hardcopy after initial data entry. Databases will be saved to 2 separate backup mediums after each data entry session. Each park will receive copies of the databases containing information collected within their boundaries and data additionally may be posted on the regional inventory website. Copies of the databases will also be submitted to the network coordinator.

Data will be transferred or entered into the following NPS service-wide biological databases by the biological technicians at the end of the field season: NPSpecies, ANCS+, NRBib, and the Dataset Catalog. GIS data layers will be generated and incorporated into the GIS Theme Manager. Metadata for GIS products will be coordinated with the Regional GIS team in Anchorage and the park GIS specialist.

Data Analysis

Estimation of absolute abundance on the 1 ha grid will be assessed using the generalized removal models of Otis et al. (1978), as implemented in the program CAPTURE (Rexstad and Burnham 1992) along with program MARK (White and Burnham 1999).

Species richness at the ecosection level will be estimated using the community-level generalization of capture-recapture estimators, in which replicate sites constitute 'occasions' and species constitute 'individuals'. Based on the estimation detection probabilities of species, the estimated number of species in a section can be calculated. This technique can also be employed to estimate the number of species in a park unit. This sampling/analytical framework lays the foundation for subsequent estimation of species turnover rate, should successive monitoring sampling be undertaken in the future (Boulinier et al.1998, Nichols et al. 1998, Dr. Eric Rexstad, University of Alaska, personal communication). At a coarser level of resolution, species occurrence can also be predicted by ecological section, given this is the stratification mechanism employed in the sampling design.

Habitat characterization data collected on each plot will be used to develop habitat association models via methods of logistic regression (Hosmer and Lemeshow 1989) or classification and regression trees (Breiman et al. 1984).

Project Timeline

January 2001 – April 2001
Purchase equipment and supplies.
Hire a graduate student.
Set up research work order with University of Alaska Fish and Wildlife Cooperative studies Unit via US Geological Survey-Alaska Biological Science Center.
Coordinate with UAM to finalize fieldwork colloboration.

April 2001 – June 2001
Refine sampling design and field methods.
Hire biotechs and volunteers.

July 2001 – August 2001
Train all field personnel: bears, shotguns, cpr/1st aid, helicopter safety, small mammal identification, and study skin preparation.

August 2001 (2nd week) – September 2001 (2nd week)
Small mammal trapping fieldwork in YUCH.

September 2001 (2nd and 3rd weeks)
Clean and store camping gear, equipment and supplies.
Begin YUCH data entry (biotechs and Graduate student).

October 2001
Principal investigator/Graduate student finishes YUCH data entry and organizes preliminary databases. Finish specimen vouchering and curation for 2001.

November 2001 – January 2002
Principal investigator/Graduate student begins data analysis and writing annual report.
Finalize annual report and submit to network coordinator.

January 2002 – January 2003
Repeat process for DENA (except for hiring a graduate student).

January 2003 – January 2004
Repeat process for WRST (except for hiring a graduate student).

December 2004
Finish final reports (Principal investigator/Graduate student).
Organize and deliver all products.

Park Contributions, Coordination and Logistic Support

Yukon-Charley Rivers National Preserve will contribute the time of 3 GS-11 biologists and 1 GS-7 biotech for portions of the field data collection. Two YUCH GS-11 wildlife biologists designed the project and wrote the study plan. It is assumed that 1 of 6 field positions will be filled by a member of the network's park staffs. John Burch (principal investigator and YUCH wildlife biologist) will coordinate with the Graduate Student for the duration of the project to ensure that project deadlines and objectives are met.

The principal investigator will work with park representatives to make use of existing equipment, modes of transportation, and supplies necessary for the inventory work. Traps from Gates of the Arctic National Park and Preserve will be used for this study. This includes 200 pit fall cones and 450 museum special snap traps. Use of fixed-wing aircraft for initial site evaluation will be contributed from individual parks. Housing or front country camping sites for 6 people will be required at the beginning and end of field stints.

Products

1. Annual report for each park (principal investigator).
2. Final report combining all 3 parks with a copy to each park (principal investigator).
3. ArcView GIS themes for each park available in the GIS Theme Manager (principal investigator).
4. MS Access database of all data collected (principal investigator).
5. Data entered into required service-wide databases NPSpecies, NRBIB, and the Dataset Catalog (principal investigator and biological technicians).
6. Photo documentations of different species and specimens (field crews).
7. Voucher specimens for all species collected and data input into ANCS+ (biological technicians).
8. Voucher specimens and frozen tissues archived and housed at UAM for future research and reference (principal investigator and biological technicians).
9. A summary poster for each park (principal investigator).
10. Web page for summarizing small mammal information collected at each park. This page will be incorporated into the network website. (principal investigator).

Budget for Central Alaska Network Small Mammal Project

	FY01	FY02	FY03	FY04	Subtotals
Personnel*					
Grad Student (out of state Ph.D.)	10,940	19,440	19,440	10,940	
UAF 10% Research work order overhead	1,094	1,944	1,944	1,094	
2 GS-5s for 6 pp/year	13,020	13,020	13,020		
OT for 2 biotech's weekends (16 days each)	4,233	4,234	4,234		
Lump sums for 2 biotechs (24 hrs each)	652	652	652		
Hazard pay for helicopter days (5 days each)	271	271	271		
Personnel Subtotal:					**121,366**
Supplies and Equipment					
500 Museum specials traps $5.40/trap	2,700	540	540		
100 110 conibear traps, $3.00/trap	300	45	45		
50 additional pit fall cones, $12.00/cone	2,760	60	60		
Printing of final reports				200	
Curation					
Nitrogen Containers, $600.00/cont.	2,400	600	600		
Nitrogen charging $120.00/charge/camp	720	720	720		
4-3 gal. Nalgene ethanol carboys w/ ethanol	400	200	200		
UAM contract for specimen processing charge, $10/specimen (includes 25% indirect cost for UAM)	2,780	1,500	1,800		
Misc. supplies	500	500	500	200	
Supplies and Equipment Subtotal:					**21,290**
Travel					
Initial set up and travel to park for both crews	500	500	500		
Set out 2 camps with R44 7.5 hrs/yr.	3,800	3,800	3,800		
3 moves of both camps with R44 26 hrs/yr.	11,500	11,000	11,000		
Pull camps with R44 7.5 hrs/yr.	3,600	3,600	3,600		
Travel for both crews back to town	500	500	500		
Travel & stipend for 2 Volunteers	2,000	2,000	2,000		
Food/per diem for 6 people for 6 weeks	4,788	4,788	4,788		
400 gal avgas @ 2.90/gal	1,160	1,160	1,160		
Travel Subtotal:					**82,544**
Annual totals	**70,618**	**71,074**	**71,374**	**12,434**	
Total Budget Request for Small Mammal Inventory Project:					**225,500**

* 1 of the 6 field positions will be provided in some capacity by park staff—salaries for these individuals will be paid by their respective park base funds. YUCH base operating funds covers salary for John Burch as Principal Investigator (3-4 months intermittent).

FRESHWATER FISH INVENTORY PROJECT DESCRIPTION

Principal Investigator: Eric Veach (WRST)

Problem Statement

Freshwater fishes are an important component of ecosystems within Alaska Parks. Many issues surround freshwater fishes, particularly as the National Park Service becomes more deeply involved in subsistence fisheries management. Unfortunately, little is known about the distribution or relative abundance of many freshwater fish species within the Central Alaska Network. Most of our freshwater fish knowledge focuses on species harvested by subsistence or sport users. Of the freshwater fish species expected to occur in the each park, 88% are actually documented for YUCH, 75% for DENA, and 64% for WRST. Due to this lack of occurrence, distribution, and relative abundance information, park resource managers currently are unable to make truly informed fisheries management decisions. Without this information, accurate assessment of potential impacts to aquatic ecosystems (such as consumptive sport or subsistence fish harvest or mining and logging activities adjacent to park units) will be impossible.

Objectives

1. Determine the occurrence and distribution of freshwater fish species by watershed in the Central Alaska Network through stratified random sampling techniques and

2. Conduct targeted sampling to ensure that 90% of the freshwater fish species expected to occur in lakes and streams in the Central Alaska Network are documented.

Sampling Design

Sampling Considerations. The sampling approach developed for this project involves the combination of stratified random and targeted sampling. The stratified random sampling component will address the presence and distribution of freshwater and anadromous fish species in selected watersheds across the network. By conducting targeted sampling, habitats likely to support predicted (but not documented) freshwater fish species can be sampled; this will increase the likelihood of detecting 90% of the freshwater fish species expected to occur in each park in the network. The principal investigator will select targeted sample sites based on the habitat requirements for fish species requiring documentation. Sample location selection is also dependent on presence of existing data, management information needs, and funding limitations. Stratified random sample sites will be selected prior to determining those for targeted sampling to minimize overlap in site selection and maximize park coverage. Both random and targeted sample sites located within each park will be sampled during the same field season.

Sampling scale and stratification.--Sampling will occur at the watershed scale. Fifth order watersheds will be identified through GIS analysis and streams and lakes within them will be stratified. Where watersheds reach the ocean before becoming fifth order or where a fifth order grouping does not seem to be appropriate, professional judgment will be applied. A cursory list of the potential watersheds by park unit is displayed in Table 5.

Table 5. Potential watersheds to be sampled within each park in the Central Alaska Network. A subset of these watersheds will be selected for each park/preserve unit based on existing information, management considerations, and funding levels.

Wrangell-St.Elias	Denali	Yukon-Charley
Tributaries to Disenchantment Bay	Nenana River	Nation River
Malaspina Forelands	Teklanika River, upstream from Sanctuary Creek	Kandik River
Duktoth River	Sanctuary Creek	Yukon River, below Charley River
Kaliakh River	Savage River	Yukon River, Charley River to Nation River
Seal River	Teklanika below Savage Creek	Yukon River Nation River to Preserve Boundary
Tana River	East Fork Toklat River	Charley River
Bremner River, North, Middle & South Forks	Toklat River upstream East Fork	
Bremner R below SFK	McKinley River	
Copper R, Bremner to Chitina	Birch Creek	
Copper R, Chitina to Chistochina	Kantishna River	
Copper R, upstream Chistochina	Foraker-Heron Rivers	
Chitina R, below Nizina	Muddy River	
Chitina R, Nizina to Tana	Highpower Creek	
Chitina R, above Tana	Swift Fork Kuskokwim	
Nizina River	Tonzona River	
White River	Yentna River	
Beaver-Ptarmigan Creeks	Tributaries to Chulitna River	
Tebay River		
Kotsina River		
Chetaslina-Chesnina Rivers		
Nadina-Dadina Rivers		
Gilahina-Kuskulana Rivers		
Sanford River		
Boulder Creek		
Jacksina River		
Nabesna River		
Jack-Platinum Creeks		
Chisana River		
Snag Creek		

Within watersheds, streams will be stratified by stream order and lakes by 'connectedness' (see below) and elevation. First order streams will not be sampled as part of this effort. Second and third order streams will be combined and considered "low stream order" streams. Fourth and fifth order streams will be combined and considered "high stream order" streams. Streams that are greater than 15 percent in gradient will be assumed to be rarely fish-bearing and will not be sampled. Stream order strata will be developed through GIS, resulting in a map displaying stream order strata within fifth order watersheds.

Streams greater than fifth order will be separated into 3 approximately equal sections starting at the downstream end of NPS jurisdiction and continuing upstream to the upstream end of NPS jurisdiction. These stream sections will be divided into reaches delineated by the confluences of fifth order or larger tributaries. Watersheds that are less than fifth order, draining directly into streams larger than fifth order, will be combined with these river reaches and serve as potential low order stream sampling sites. Sampling in these river reaches will be similar to the description for sampling in streams but will likely require a boat.

Lakes will be stratified based on stream 'connectedness' to streams less than 15 percent in gradient. Lakes will be stratified as "open" (if they are connected to a stream permanently or seasonally) and "closed" (if not connected to a stream or connected only during rare high water or flooding events) and by elevation.

Sample site selection and sample size.

Targeted sampling. The principal investigator will identify lake and stream areas/habitats with a high likelihood of supporting predicted, but not documented, species. These areas will be divided into sampling units and sampled systematically. Streams will be divided into units that can be reasonably sampled within approximately 12 hours with gear appropriate for the targeted species. Each lake will be considered an individual sampling unit. These sites will be selected after reviewing sites selected during the stratified random sampling process to make sure that targeted habitats needing to be inventoried are not already being sampled. The number of sample sites inventoried under the targeted sampling approach will be left to the discretion of the principal investigator.

Stratified Random Sampling.--Within each watershed selected for stratified random sampling, 2 stream segments or lakes in each stratification category would be sampled. Using the equation

$$n = - \ln b / e$$

from Bonar et al. (1997) for determining sample size [where n is the number of sampling units to be sampled and e is the density of each predicted species encountered (e.g. sampling efficiency x mean density; equation] with b = 0.10 (assuming a capture efficiency of 25 percent) and a density of each expected species that is truly present of 4.6 fish per sampling unit, then 2 samples per category per watershed will meet our needs. Each stratification category must be sampled because we are assuming that there is an unequal probability of each expected species occurring in each stratification category. However, if adequate freshwater fish information exists for a given stratification category within the selected watershed, that category will not be sampled. Management information needs may also dictate which stratification categories are sampled within a watershed. Similarly, for streams greater than fifth order in size, 2 reaches in each section for which inadequate information or management concerns exist will be randomly selected for sampling.

Extrapolation and budget considerations.--Although some extrapolation of results downstream of sample sites may be reasonable, results should not be extrapolated upstream into watersheds where no sampling has occurred. Because we will not be extrapolating any of the data collected

beyond watershed boundaries, we can defer sampling in some watersheds without affecting the quality of the data we collect.

Due to time and funding restraints, the survey crew will only be able to accomplish approximately 100 sample sites (including both targeted and stratified sample sites) per 3-month season for 3 years. Theoretically, WRST and DENA will require approximately 8 samples per watershed (assuming the full range of habitat types occur in each watershed) and YUCH will require 4 samples per watershed if only lakes are sampled; this would result in an approximate total of 400 samples needed, which is 100 more than possible to sample even if no targeted sampling is performed. Targeted sampling will reduce the number of stratified random sample sites and reduce the total number of watersheds that can be sampled. Because of this, the principal investigator will examine existing freshwater fish data and confer with park resource management staffs to select roughly half of the watersheds for sampling during this project. In addition, the principal investigator will work with park resource management staffs to determine the percentage of targeted sampling sites vs. stratified random sampling sites in each Park/Preserve.

Methods

Our methods will involve capturing fish, collecting size, sex and condition data and vouchering specimens. Where possible, sex will be determined by external examination. For all species, lengths will be taken to the nearest millimeter; salmon will be measured from mid-eye to fork of tail and other species will be measured for total length. Weights will be taken to the nearest .01 kilogram. This information will be collected while minimizing mortality levels.

Habitat information will be collected to characterize the sample site and to verify that it meets the stratification criteria for which it was selected. In streams channel gradient, channel width, average depth and water velocity information. Habitat units will be described as pools, glides, riffles, rapids, or side channels. Lake area, length and width will be estimated. Ten water depth measurements will be taken randomly throughout each lake. Water temperature and water clarity data will be collected in both lakes and streams. Additional water quality data may be collected in conjunction with the water resources inventory team.

Fish capture methods will vary between lakes and streams. Lake sampling will be conducted using gillnets, minnow traps, hoop traps, fyke traps, hook and line sampling and visual observations for some species. Variable mesh gillnets will be fished throughout the water column. At some randomly selected lakes, crew members will camp overnight, which will provide the opportunity to perform an additional evening set of nets and traps as well as hook and line sampling. Visual observations of easily identified fish species, such as adult salmon, Arctic grayling, and northern pike will be included in the data set. Lake sampling will require an inflatable raft with a motor and transportation to most sample sites will be by floatplane or helicopter.

Stream sampling will include use of minnow traps, beach seines, drift gillnets, hook and line sampling, dipnets, visual observations, and backpack electrofishers as appropriate. Six to 30 minnow traps will be deployed per site in a range of habitat types (pools, riffles, eddies, side channels) where possible. A combination of trap baits will be used, salmon eggs, dry cat food, canned tuna or salmon. Beach seines and dipnets will be used where conditions permit. Where existing information, or preliminary sampling with methods other than electrofishing, indicates that rainbow trout or steelhead do not exist, backpack electrofishers will be used in small streams. Should this method be employed, crew members will install block nets at the upstream and downstream ends of an approximately 100 meter stream segment that encompasses at least 2 habitat types (pools, riffles, side channels) prior to electrofishing and will then make a minimum of 2 passes electrofishing removing captured fish. A pass will be considered the combination of

electrofishing once upstream and downstream through the stream segment. Some discretion as to the combination of specific methods utilized at each site will be left to the field crew leader. For example, where beach seines can be successfully fished, electrofishing will not be necessary or if electrofishing is necessary then it will likely be the only method utilized. Floatplane and helicopter transport will be required to reach sample sites and put-in points for sampling requiring raft access.

It is understood that the geographic distribution of fish varies from season to season. Not all species endemic to a drainage will be present in a particular location at any given time. For this reason, habitats selected for sampling will be selected to optimize the probability capture of all species thought to be likely to occur within that watershed.

Crewmembers will record sampling effort and conditions affecting the success of sampling efforts at each site. Throughout the season we will estimate capture efficiency for each gear type in different habitats. If capture efficiency consistently appears lower than the assumed 25 percent, the principal investigator will meet with Park Resource Management Chiefs to determine if we should increase the number of sample sites, thereby reducing the number of watersheds sampled, or accept the lower level of confidence in the results.

Vouchers

Sampling mortality will be kept to a minimum. Some mortality is expected and specimens killed while sampling will be used to produce a voucher collection. Collection of specimens will be limited to species not easily identified in the field such as juvenile salmon and whitefish; fish accidentally killed during capture; and species not previously documented in the network. Single specimens of all rare or unknown taxa and fin clips from at least 40 individuals (where possible) from the common taxa per site will be archived for genetic processing. Fin clips will be stored in ethyl alcohol. Long term storage of the specimens will be arranged with University of Alaska Museum. Incidental catch or observations of amphibians also will be documented.

Data Management

All crewmembers will be trained in fish capture techniques, identification, specimen preparation, habitat measurements and data recording techniques. Assistance from UAM curator of fishes will be requested to ensure collection techniques reflect museum standards and data needs. Specimen identification will be verified at UAM by trained fish collections personnel.

The GS-5 Fishery Technician will conduct a literature search for all available freshwater fish information for each park unit in the first year of the inventory. The GS-9 Fishery Biologist will be responsible for data collection, data entry, updating the national databases (NPSpecies, ANCS+, NRBib, and the Dataset Catalog) and working with appropriate individuals to produce GIS products displaying the results. The GS-9 Fishery Biologist will enter data into an Excel spreadsheet that will be imported into an Access database once the data entry is completed. All data will be profed from hardcopy after initial data entry. The Access database will be linked to a GIS coverage produced in ArcInfo. Each park will receive copies of the databases containing information collected within their boundaries and data additionally may be posted on the regional inventory website. The principal investigator will be responsible for writing the final report.

Two copies of datasheets will be made, one copy will be stored with the inventory coordinator and the second copy will be stored at WRST with the principal investigator until the final report is completed. Detailed field notes will be kept by all field staff and retained as part of the permanent archival information for the project.

Data Analysis

Species will be determined to be present within a watershed if they are found or previously documented as present at sample sites within the watershed. We will not sample intensively enough to document absence. Using capture efficiency and sample size we may be able to determine the probability that an undocumented species is present at or below a specific density.

Indices of relative abundance will be developed by comparing capture efficiencies, effort, and catch of each species. Distribution will be displayed by watershed. Indices of relative abundance will be displayed with the distribution map.

Project Timeline

October 2000 through April 2001
Assemble workforce (principal investigator)
Complete literature search for all existing freshwater fish inventory data for each park unit
Enter existing freshwater fish inventory data into GIS database
Use GIS to stratify waterbodies and randomly select sample sites
Develop database structures and link to GIS layers
Refine individual park inventory study plans
Coordinate logistics including OAS and housing
Purchase equipment

May 2001 through September 2001
Initiate freshwater fish inventories in WRST

October 2001 through April 2002
Review first field season and refine study plans if needed
Compile, enter and analyze data and produce GIS layers
Prepare annual progress report

May 2002 through September 2002
Complete inventories in WRST, begin in YUCH

October 2002 through April 2003
Compile, enter and analyze data and produce GIS layers
Prepare annual progress report

May 2003 through September 2003
Complete YUCH and DENA inventory

October 2003 through December 2004
Complete compilation and analysis of data.
Finalize GIS layers in Arcview showing results.
Produce copies of Access data on CD media.
Enter data into NPSpecies and ANCS+.
Produce final report summarizing results.

Park Contributions, Coordination and Logistical Support

WRST will contribute a GS-12 Fishery Biologist to serve as the principal investigator through the duration of the project. The principal investigator will supervise the GS-9 Fishery Biologist whom will be hired under a term appointment in FY 2001. The GS-9 Fishery Biologist will supervise the GS-5 Fishery Technician and conduct fieldwork. For surveys on WRST, coordination will be through the principal investigator. For surveys on DENA and YUCH, the principal investigator and crew leader will coordinate with Fred Andersen, Fishery Biologist for DENA and YUCH.

WRST will provide one electrofisher and accessories. Each park unit will supply boats, motors, and safety equipment necessary for this work.

When possible Parks/Preserves will provide aircraft currently assigned to the unit. This may include a Husky on floats at WRST and the FirePro helicopter. Rates for these aircraft would be less expensive than those displayed in the budget, which will increase the number of sites that can be sampled under the proposed budget.

Products

The project will produce written reports (annual progress and final reports) describing the methods used, effort, results and a discussion of the results for each park unit. Written reports will be reviewed by the network coordinator and forwarded on to the regional I&M coordinator for incorporation into the regional inventory website. The project will produce a network-wide Access database on CD media of the survey results that can be updated as additional surveys are performed. The project will produce Arcview GIS layers by watershed showing the distribution and relative abundance of each documented species; hard copy maps also will be produced. Information collected will be used to update national databases NPSpecies, NRBib, and the Dataset Catalog.

Voucher specimens will be identified, labeled, cataloged in ANCS+ (the NPS collections database), and housed with the University of Alaska Museum collections.

Budget for Central Alaska Network Freshwater Fish Project

	FY2001	FY2002	FY2003	FY2004	Subtotals
Personnel					
GS-9 Fish Biologist-Crewleader 5 months/year	19,000	19,000	19,000		
1 GS-5 Fish Technician 4 months FY01, 3 months FY02-03	9,000	7,000	7,000		
Overtime and Hazard Pay	1,500	1,500	1,500		
Personnel Subtotal:					**84,500**
Travel					
Travel and per diem @$19/day	2,000	2,500	3,000		
OAS C-185 on floats 5h/day @290/hr	27,000	27,000	12,500		
Helicopter @$3000/day	30,000	9,000	45,000		
Travel Subtotal:					**158,000**
Equipment and Supplies					
1 Electrofisher and accessories	5,000				
Nets	3,000				
Boat Gas/oil	400	400	400		
Misc gear repair/replacement	2,000	1,100	1,300		
Voucher/collection supplies	500	200	200		
Equipment and Supplies Subtotal:					**14,500**
Services					
Curation costs for University of Alaska Museum (includes 25% overhead)	2,000	2,000	2,000		
GIS support (contract) Created layers based on sample data		2,500	2,500	2,500	
Services Subtotal:					**13,500**
Annual Totals:	**101,400**	**72,200**	**94,400**	**2,500**	
Total Budget Request for Freshwater Fish Inventory Project:					**270,500**

LITERATURE CITED

Banfield, A. W. F. 1960. Notes on the mammals of the Kluane Game Sanctuary, Yukon Territory. Nat. Mus. Can. Bull. 172, Biol. Ser. 65, contrib.. Zool. 1959:128-135.

Bonar, S.A., M. Divens, and B. Bolding. 1997. Methods for sampling the distribution and abundance of bull trout and dolly varden. Washington Department of Fish and Wildlife. Olympia, Washington.

Boulinier, T., J.D. Nichols, J.R. Sauer, J. E. Hines, and K.H. Pollock. 1998. Estimating species richness; The importance of heterogeneity in species detectability. Ecology 79:1018-1028.

Breiman, L., J.H. Friedman, R.A. Olshen, and C.J. Stone. 1984. Classification and regression trees. Wadsworth and Brooks, Monterey CA.

Britten M. and C. McIntyre. 1986. A preliminary survey of plants, birds and mammals in the vicinity of placer mining disturbance in the coal creek drainage, August 5-18, 1986. Research and Resource Management Report Series 82-02. U.S. National Park Service. Yukon-Charley Rivers National Preserve.

Busing, R., Rimar, K., Stolte, K.W., Stohlgren, T. J. and K. Waddell. 2000. Forest Health Monitoring Vegetation Pilot Field Methods Guide: Vegetation Diversity and Structure, Down Woody Debris, Fuel Loading, May 2000. National Forest Health Monitoring Program, Research Triangle Park, North Carolina.

Clark, M. 1997. Draft Ecoregion subsections map for Denali National Park and Preserve, National Resource Conservation Service, Alaska Region.

Cleland et. al. 1997. National hierarchical framework of ecological units. Pp. 181-200 in: Ecosystem management (ed. M. S. Boyce and Haney). Yale University, New Haven CT, 361 pp.

Clough, 1976. Mammals of the Yukon-Charley area. In: Young, S.B. (ed.). The environment of the Yukon-Charley Rivers area. Final Report. The Center for Northern Studies for National Park Service. Wolcott, Vermont.

Cook, M. B. 1994. Progress report for vascular plant inventory within Wrangell-St. Elias National Park and Preserve. Unpub. Report. 15 pp.

_____. 1995. Progress report for vascular plant inventory within Wrangell-St. Elias National Park and Preserve. Unpub. Report. 20 pp.

_____. 1999. History of botanical collecting within Wrangell-St. Elias National Park and Preserve. Chapter 2, 101 pp. In: A vascular plant inventory of selected sites north of the Bagley Ice Field within Wrangell-St. Elias National Park and Preserve. Report in progress.

_____ and C. Roland. In prep. A vascular plant inventory of selected sites north of the Bagley Icefield within Wrangell-St. Elias National Park and Preserve, Alaska. Report in progress. 60 pp.

_____and_____. In prep. Notable vascular plants from Wrangell-St. Elias National Park and Preserve, Alaska. Article in progress for the Canadian Field Naturalist.

_____ and _____. In prep. A field guide to the rare vascular flora of Wrangell-St. Elias National Park and Preserve. 152 pp.

Dixon, J.S. 1938. Birds and Mammals of Mount McKinley National Park, Alaska. Fauna of the National Parks of the United States. Fauna series no. 3. Washington D.C.

Donnell, B.J. 1984. Wildlife observation card sighting of a water shrew at Little Stoney Creek.

Goff, F.G., G.A. Dawson, and J.J. Rochow. 1987. Site examination for threatened and endangered plant species. Environmental Management. 6:307-316.

Hanson, D. 2000. Biological Inventories Scoping Meeting Summary. National Park Service, Alaska Support Office, 2525 Gambell St., Room 107, Anchorage, AK 99503-2892.

Hosmer, D.W., and S. Lemeshow. 1989. Applied logistic regression. John Wiley and Sons, New York.

Hulten, E. 1941-1950. Flora of Alaska and the Yukon. 10 Vols. Lunds University. 1902 pp.

Krebs, C. J. and I. Wingate 1976. Small Mammal Communities of the Kluane Region, Yukon Territory. The Canadian Field-Naturalist 90(4):379-389.

Lachelt, T.C. 1953. Observations (mammals) in Mt. McKinley National Park: Oct 15-Dec 25, 1952.

MacDonald, S. O. 1979. Small mammals collected in the vicinity of Chisana, Alaska, 13-15 June 1979.

Manville, R.H. and Young, S.P. 1965. Distribution of Alaskan Mammals. Bureau of Sports Fisheries and Wildlife. Washington D.C. 76p.

Mitchell, C. D. 1998. Provisional list of wild mammals for Wrangell-St. Elias National Park and Preserve, Alaska. Wildlife Biologist, Research and Resource Management, Wrangell-St. Elias National Park and Preserve, Copper Center, Alaska.

Murie, A. 1962. Mammals of Mount McKinley National Park, Alaska. Mount McKinley. Alaska Natural History Association. 56p.

Nelson, J.R. 1987. Rare plant surveys: techniques for impact assessment. In: T.E. Elias (ed). Conservation and Management of Rare and Endangered Plants, Proceedings from a Conference of the California Native Plant Society. Sacramento: The California Native Plant Society. 630 pp.

Nichols, J. D., T. Boulinier, J. E. Hines, K. H. Pollock, and J.R. Sauer. 1998. Estimating rates of local extinction, colonization, and turnover in animal communities. Ecological Applications 8:1213-1225.

Parker, C. and D. Murray. 1992. Collecting Voucher Specimens for Documentation. Unpublished report prepared for the Alaska Rare Plant Working Group. University of Alaska, Fairbanks.

Otis, D.L., K.P.Burnham, G.C. White, and D.R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildlife Monographs 62:1-133.

Rexstad, E., and K. P. Burnham. 1992. Users guide for program CAPTURE. Colorado Cooperative Fish and Wildlife Research Unit, Ft. Collins CO.

Roland, C. A. 1998. Floristic Inventory of Denali National Park and Preserve project annual report. 13 pp.

Roland, C. A. 1999. Floristic Inventory of Denali National Park and Preserve project annual report. 24 pp.

Shults, B.S., L.G. Adams, and F.C. Dean. 1993. Population dynamics of a harvested marten population in Interior Alaska. National Park Service. Anchorage, AK.

Swanson, D. 1999. Ecological units of Yukon-Charley Rivers National Preserve, Alaska. YUCH Technical Report 99-001.

Teare, K. 1984. Standard Operating Procedures for Collecting Plant Specimens and Curating the Park herbarium. Unpublished report. Wrangell-St. Elias National Park and Preserve. 20 pp.

University of Alaska Museum. 2000. Summary database of the UAM Mammal collection. Last update March 14, 2000. Internet site: http://www.uaf.edu/museum/mammal/index.html

Viereck, E. N. 1959. Small mammal populations in Mount McKinley National Park, Alaska. Unpub. PhD. dissertation. Univ. of Colorado. 177pp.

_____, C.T. Dyrness, A.R. Batten and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. RNP-GTR-286. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station, 278 pp.

Wesser, S. 2000. Annual Report of the Alaska Region's Biological Inventory Program, Fiscal Year 2000. National Park Service, Alaska Support Office, 2525 Gambell St., Room 107, Anchorage, AK 99503-2892.

White, G.C. and K.P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46 Supplement, pp. 120-138.

Wilson, D.E., F.R. Cole, J.D. Nichols, R. Rudran, and M.S. Foster (Eds.). 1996. Measuring and monitoring biological diversity: standard methods for mammals. Smithsonian Institution Press, Washington, DC. 409 pp.

APPENDIX I. RESUMES OF PRINCIPAL INVESTIGATORS AND KEY COWORKERS FOR INVENTORY PROJECTS IN THE CENTRAL ALASKA NETWORK.

Plant Inventory

Mary Beth Cook (Principal Investigator)

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Mary Beth Cook has been a botanist at Wrangell-St. Elias National Park and Preserve since 1986 and has been managing the vegetation resources program there since 1996. She was project lead for an inventory of the park's vascular flora north of the Bagley Icefield from 1994-1997. Prior to this she was either project lead or one of the primary field investigators for numerous vegetation studies including: an inventory of forest resources along the Nabesna and McCarthy Roads in 1986; a study of the effects of drilling muds on vegetation at Sudden Stream on the Malaspina Forelands in 1987; a study to describe and monitor vegetation changes on three mining access routes near Gold Hill from 1989 to 1990; an air quality study using lichens as bio-indicators in 1990; a study to monitor re-vegetation after glacial recession in Icy Bay in 1992 and a study of habitat use by caribou in 1993. She conducted vegetation mapping throughout the park in 1987 and 1992; has conducted vascular plant inventories in numerous areas throughout Alaska, in California, Arizona and in New Mexico; conducts wetland delineations and rare plant surveys for environmental assessments within the park; maintains park vascular and non-vascular plant species lists; manages the park herbarium; participates in visitor use planning and in the development of the inventory and monitoring program at the park. Cook received a Bachelor of Arts in Social Sciences in 1981 from the University of California, Irvine and received a Master of Science degree in 1986 from California State University, Fullerton where she studied hybridization between two species of *Dodecatheon* (Primulaceae) in the southern Sierra Nevada, California.

Selected references:

Cook, M.B., R. Lipkin and P. Knuckles. 1993. Floristic Survey of Two Sites in the Ogilvie Mountains and a slope near Hillard Peak. Resource Management Report Series 93-05. Yukon-Charley Rivers National Preserve. 39 pp.

Cook, M.B. 1994 & 1995. Progress reports for a vascular plant inventory within Wrangell-St. Elias National Park and Preserve. Unpub reports. 15 pp. & 20 pp.

Cook, M.B. 1999. History of botanical collecting within Wrangell-St. Elias National Park and Preserve. Chapter 2, 101 pp. In: A vascular plant inventory of selected sites north of the Bagley Ice Field within Wrangell-St. Elias National Park and Preserve. Report in progress. 190 pp.

Cook M.B. 1998. Vegetation documentation for the Bremner cultural landscape study. Research and Resource Management Report 98-3. 30 pp.

Cook, M.B. 1998. Ahtna uses of plants occurring at the Wrangell-St. Elias National Park & Preserve visitor center site. Research and Resource Management Report No. 98-4. 54 pp.

Cook, M.B. and C.A. Roland. 1996. At the crossroads, a vascular floristic inventory of Wrangell-St. Elias National Park and Preserve. Poster presented at the George Wright Society Meeting in New Mexico in 1996.

Cook, M.B. and C.A. Roland. 2000. A field guide to the rare vascular flora of Wrangell-St. Elias National Park and Preserve. 152 pp. Draft document, seeking funds for publication.

Cook, M.B. and C.A. Roland. 2000. Notable vascular plants from Wrangell-St. Elias National Park and Preserve. Draft paper for submission to the Canadian Field Naturalist including 200 Alaska and park distribution maps. 140 pp.

Jenkins, K.J., M.B. Cook, P.J. Happe and L.C. Christensen. 1997. Monitoring vegetation trends on the Mentasta caribou range, Wrangell-St. Elias National Park and Preserve. Research and Resource Management Report 97-1. 69 pp.

Roland, C. A. and M. B. Cook. 1998. A notable range extension for the globally rare endemic plant, Cryptantha shackletteana L.C. Higgins, in East-central Alaska. 1998. Canadian Field naturalist 112(1):158-160.

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WORK EXPERIENCE:

4/2000- present	Plant Ecologist	Denali National Park and Preserve - Denali Park, AK
10/98-4/2000	Botanist	Denali National Park and Preserve - Denali Park, AK
5/98-9/98	Biological Technician	Denali National Park and Preserve - Denali Park, AK
4/95-4/98	Botanist	Wrangell-St. Elias National Park and Preserve - Copper Center, AK
5/94-4/95	Biological	Wrangell-St. Elias National Park and Preserve, - Copper Center, AK
9/91-6/93	Teaching Assistant	University of Alaska, Fairbanks
5/91-9/91	Biological Technician	Yukon-Charley Rivers National Preserve - Eagle, AK
4/90-11/90	Biological Technician	Yukon-Charley Rivers National Preserve - Eagle, AK

Short Term Projects/Contracts

07/98	Botanist	Univ. of Alaska-Museum – Nulato Hills, AK
12/94-2/95	Botanist/Plant Ecologist	Univ. of Alaska Dept. of Biology and Wildlife – Venezuela and Peru
6/92-7/92	Plant Ecologist/Botanist	UAF-National Geographic Society; Russian Far-East
3/87 and 5/87	Plant conservation technician	Nature Conservancy – Santa Cruz Island, CA

EDUCATION :

Master of Science, Botany. University of Alaska, Fairbanks – 1996
Bachelor of Arts, Environmental Studies - Agroecology. University of California, Santa Cruz – 1986

PRESENTATIONS:

- Results of floristic inventory studies in Denali National Park – Alaska Rare Plant Forum, Fairbanks, AK. April 2000
- Computer Databases and Developing an Alaska Regional Plant Inventory Strategy – Alaska Natural Resource Management Mtg., Anchorage, Ak. (Spring 1999)
- Floristic Inventory of Denali National Park and Preserve – Results from the First Year – Alaska Rare Plant Forum Annual Meeting, Anchorage, AK. (Spring 1999)
- The Biogeography and Distribution of Endemic Plants in Wrangell-St. Elias National Park in Relation to Other Regions of Alaska – Alaska Rare Plant Forum (1997)
- Results from the Floristic Inventory of Wrangell St. Elias National Park and Preserve (poster) George Wright Society Mtg, Albuquerque, NM (Spring 1997)
- Wrangell-St. Elias Floristic Inventory -- Results and Future Projects – 1996 Alaska Rare Plant Working Group Mtg.
- The Vegetation and Flora of Extrazonal Steppe in the Yukon and Kolyma River Drainages
  - Trends in Species Diversity and Topographic Control of Vegetation Thesis Defense, Dept of Biology and Wildlife, University of Alaska Fairbanks (Dec. 1995)

PUBLICATIONS

- Monograph on Flora of Wrangell-St. Elias National Park and Preserve – Taxa New to Alaska, Range

Extensions and Rare Plants – M.B. Cook and C.A. Roland (in prep., to be submittted for publication in Can. Field Naturalist

- A Notable Range Extension for the Globally Rare Endemic Plant Cryptantha shackletteana in East-Central Alaska C.A. Roland and M.B. Cook Can. Field Naturalist
- The Floristics and Community Ecology of Extrazonal Steppe in the Yukon and Kolyma River Drainages (M.S. Thesis, Univ. of Alaska, Fairbanks 1996. 205 pages)

RECENT REPORTS (last three years)

- Floristic Inventory of Denali National Park and Preserve Annual Report – February 2000
- Annual Summary and Proposed Budget for Denali Vegetation Monitoring Program FY2000 - October 1999
- Objectives for Long Term Vegetation Monitoring Project, Denali National Park and Preserve – April 1999
- Snowmacine impacts to Vegetation in Denali National Park (March 1999)
- Summary and Analysis of Vegetation Data from Denali Long Term Ecological Monitoring Vegetation Plots 1992-1998 Jan.1999
- Evaluation of Existing Protocols for Long Term Ecological Monitoring in Denali National Park - Dot Helm and Carl Roland – February 1999
- Annual Report on Long Term Vegetation Monitoring for Servicewide LTEM Bulletin - March 1999
- Floristic Inventory of Denali National Park and Preserve Annual Report – December 1998
- Introduction and Background for: Rare and Endemic Plants of Wrangell-St. Elias National Park and Preserve (60 pages) – Spring 1997

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Education:

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M.S.	Botany, 1977, University of Alaska Fairbanks

Employment:

1984-Present	Research Associate, University of Alaska Museum
1977-1984	Research Associate, Institute of Arctic Biology, University of Alaska Fairbanks
1976	Research Assistant, School of Agriculture and Land Resources Management, University of Alaska Fairbanks
1972-1975	Herbarium Assistant, University of Alaska Museum

Select Publications:

Batten, A. R., D. F. Murray, and J. C. Dawe. 1979. Threatened and endangered plants in selected areas of the BLM Fortymile Planning Unit, Alaska. U.S. Dep. Interior, Bureau of Land Management Alaska Technical Report 3. 127 pp.

Batten, A. R. and D. F. Murray. 1982. A literature survey on the wetland vegetation of Alaska. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. 222 pp.

Batten, A. R. 1990. A synopsis of Alaska wetland vegetation. Pages 23-44 *in* van der Valk, A. and J. Hall, organizers, Alaska: regional wetland functions, proceedings of a workshop held at Anchorage, Alaska May 28-29, 1986. The Environmental Institute Publication 90-1, University of Massachusetts, Amherst.

Batten, A. R. and D. F. Murray. 1993. Beaches, dunes and cliffs of coastal Alaska. Pages 23-37 *in* van der Maarel, E., editor, Dry Coastal Ecosystems, Polar Regions and Europe. Ecosystems of the World 2A. Elsevier, New York.

Viereck, L. A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska vegetation classification. U.S. Dep. Agriculture, Forest Service, Pacific Northwest Research Station Gen. Tech. Rep. PNW-GTR-286. 278 pp.

Reports:

Batten, A. R. 1974. Vegetation of the John River valley. Report to the Bureau of Outdoor Recreation, Anchorage, Alaska. 13 pp.

Batten, A. R. 1977. The vascular floristics, major vegetation units, and phytogeography of the Lake Peters area, northeastern Alaska. University of Alaska M.S. thesis. 330 pp.

Murray, D. F. and A. R. Batten. 1977. A provisional classification of Alaskan tundra. Final report to the U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 134 pp.

Batten, A. R., S. Murphy, and D. F. Murray. 1978. Definition of Alaskan coastal wetlands by floristic criteria. Final report to the U.S. Environmental Protection Agency, Corvallis Environmental Research Lab., Corvallis, Oregon. 490 pp.

Batten, A. R., J. C. Dawe, and D. F. Murray. 1978. Threatened and endangered plants in selected areas of the Fortymile Planning Unit, Alaska. Report to the U.S. Dep. Interior, Bureau of Land Management, Fairbanks, Alaska. 201 pp.

Batten, A. R. 1979. Wetlands of the Kenai River corridor. Map of wetland vegetation types, scale approximately 1:63,360, on overlays to U-2 color-infrared imagery, produced for the U.S. Fish and Wildlife Service, Anchorage, Alaska.

Batten, A. R. 1980. A proposed classification framework for Alaskan wetland and aquatic vegetation. Final report to the U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 135 pp.

Viereck, L. A., C. T. Dyrness, and A. R. Batten. 1982. 1982 Revision of preliminary classification for vegetation of Alaska. U.S. Forest Service, Institute of Northern Forestry, Fairbanks, Alaska. 72 pp.

Viereck, L. A., C. T. Dyrness, and A. R. Batten. 1986. The 1986 Revision of the Alaska vegetation classification. U.S. Forest Service, Institute of Northern Forestry, Fairbanks, Alaska. 195 pp.

Reviews:

Batten, A. R. 1982. Geobotanical atlas of the Prudhoe Bay region, Alaska, by D. A. Walker, K. R. Everett, P. J. Webber, and J. Brown. Arctic and Alpine Research 14:175-176.

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Education:

A.B. Middlebury College, 1959, with Honors in Biology
M.S. University of Alaska, 1961, Wildlife Management
University of Vermont, 1961-1962
Ph.D. University of Colorado, 1966, Systematic Botany

Employment:

1994- Retired as of 1 January 1994, received rank of Professor of Botany and Curator Emeritus 8 May 1994
1977- 1993 Professor of Botany and Curator of the Herbarium, University of Alaska Fairbanks
1970-1977 Associate Professor of Botany and Curator of the Herbarium, University of Alaska Fairbanks
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1966-1969 Assistant Professor of Botany and Curator of the Herbarium, Memorial University of Newfoundland

Select Publications:

Murray, D. F. 1968. A plant collection from the Wrangell Mountains, Alaska. Arctic 21:106-110.
Murray, B. M. and D. F. Murray. 1969. Notes on mammals in alpine areas of the northern St. Elias Mountains, Yukon Territory, and Alaska. Can. Field-Nat. 83: 331-338.
Murray, D. F. 1970. Carex podocarpa and its allies in North America. Can. J. Bot. 48: 313-324.
Murray, D. F. 1971. Notes on the alpine flora of the St. Elias Mountains. Arctic 24: 301-304.
Murray, D. F. 1978. Vegetation, floristics, and phytogeography of northern Alaska, pp. 19-36. In L. Tieszen, ed. Vegetation and Production Ecology of an Alaskan Arctic Tundra. Springer-Verlag, New York.
Murray, D. F. 1980. Endangered and threatened plants in Alaska. (An illustrated manual) USFS/BLM. 59 pp.
Murray, D. F., B. M. Murray, and A. W. Johnson. 1980. Floristic survey, pp. 42-46. In J. Brown and R. L. Berg, eds. Environmental engineering and ecological baseline investigations along the Yukon River--Prudhoe Bay Haul Road. CRREL Rept. 80-19, Cold Regions Research and Engineering Laboratory, Hanover.
Murray, B. M. and D. F. Murray. 1982. Bryological field guide Dalton Highway, Alaska, Yukon River to Prudhoe Bay. Univ. Alaska Museum Studies 1. 47 pp.
Murray, D. F., B. M. Murray, B. A. Yurtsev, and R. Howenstein. 1983. Biogeographic significance of steppe vegetation in subarctic Alaska. Proc. Fourth Intern. Permafrost Conf., pp. 883-888.
Murray, D. F. 1987. Breeding systems in the vascular flora of arctic North America, pp. 239-262. In K.M. Urbanska, ed. Differentiation Patterns in Higher Plants. Academic Press, London.
Murray, D. F. and R. Lipkin. 1987, 2nd edition, revised. Candidate Threatened and Endangered Plants of Alaska. University of Alaska Museum, Fairbanks. 76 pp.
Murray, D.F. 1990. Flora and vegetation of the Arctic: International cooperation, pp. 261-262. In V.M. Kotlyakov and V.E. Sokolov, eds. Arctic Research, Part 2. Academy of Sciences USSR, Moscow.
Murray, D.F and B. A. Yurtsev. 1990. Panarctic Floras. Newsletter No. 14, International Organization of Plant Biosystematists: 3-7.

Murray, D. F. and V. Neronov. 1992. The Panarctic Biota Project. Man in the Biosphere, Northern Sciences Network Newsletter, April No.1: 10-11.
Murray, D.F. 1992. Vascular plant diversity of Alaskan arctic tundra. NW Environmental Journal 8: 29-52.
Murray, D. F. 1994. Floristics, systematics, and the study of arctic vegetation: a commentary, Journal of Vegetation Science 5: 777-780.
Murray, D. F. 1995. Causes of arctic plant diversity: origin and evolution, pp. 21-32. In, F.S. Chapin III and C. Korner, eds. Arctic and alpine biodiversity: patterns, causes and ecosystem consequences. Springer, Heidelberg.
Murray, D. F. 1997. Regional and local vascular plant diversity in the Arctic. In Jonsell, B. and Borgen, L. (eds.) Variation and Evolution in Arctic and Alpine Plants. Proc. VI Intern. IOPB Symposium, Tromsoe. Opera Botanica 132: 9-18.

Reports:

Murray, D. F. 1969. Ecological studies on a nunatak of the Kaskawalsh Glacier, Yukon Territory. Final Report to Arctic Institute of North America for Grant IRRP-94. 37 pp.
Murray, B. M. and D. F. Murray. 1973. Checklist of plants for Alaska US-IBP Tundra Biome Study Areas. Final report for Project 5111. 93 pp. Expanded and distributed as U.S. Tundra Biome Data Report 73-30. 104 pp.
Murray, D. F. and B. M. Murray. 1974. Field Report. Botanical studies in the Arctic National Wildlife Range. Submitted to U.S. Fish and Wildlife Service via Averill Thayer, Refuge Manager, ANWR, Fairbanks. 21 pp.
Murray, D. F. 1974. Notes on the botany at selected localities in the Alatna and Killik River valleys, Central Brooks Range, Alaska. Final Report for National Park Service, Contract CX-9000-3-0125. 308 pp.
Batten, A. R. and D. F. Murray. 1976. The botany of Alaska wetlands. Final Report for the Department of the Army Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss. for P.O. DACW 39-76-M- 2473. 230 pp. Subsequently distributed as Tech. Rept. Y-82-2, Wetlands Research Program, U.S. Army Engineer Waterways Expt. Sta.
Murray, D. F. 1978. Alpine flora of the northern St. Elias Mountains, Yukon Territory and Alaska. Final Report to Arctic Institute of North America. 60 pp.
Batten, A. R., J. C. Dawe, and D. F. Murray. 1978. Threatened and endangered plants in selected areas of the Fortymile Planning Unit inthe State of Alaska. Final Report to the Bureau of Land Management for Contract No. YA-512-CT8-162. 201 pp.
Murray, D. F., B. M. Murray, and A. W. Johnson 1979. Botanical Reconnaissance in northern Alaska. Final Report to CRREL for P.O. DACA89-79-Q-0717. 17 pp. Distributed as CRREL Internal Report 623, 1980.
Murray, D. F. 1979. Natural landmark site evaluations: Arctic Lowlands. Final Report to the Heritage Conservation and Recreation Service for Contract CX-9000-7-0052.
Murray, D. F., B. M. Murray, and A. W. Johnson. 1980. Botanical inventory of NPRA Test Wells-1980. Submitted to John Haugh, U.S. Geological Survey, NPRA Office, Anchorage. 7 pp.
Murray, D. F. 1981. Status reports and environmental assessments for six rare plants taxa proposed for threatened or endangered status. Final Report to U.S. Fish and Wildlife Service, Anchorage for P.O. 70181-1608 and 70181-0044-81. 97 pp.
Murray, D. F. 1988. A taxonomic reevaluation of Thlaspi arcticum. Final Report to U.S. Fish and Wildlife Service, Fairbanks for Cooperative Agreement No: 14-16-009-1535, RWO 34. 12 p.
Murray, D. F. and B. M. Murray. 1993. 1992 Panarctic Flora Project Expedition, Bering Land Bridge National Preserve, Seward Peninsula, Alaska. Research Work Order 55, Amendment B, Agreement No. IA-9700-1-9014. 6 pp.

Reviews:

Murray, D. F. 1973. Arctic adaptations in plants, by D.B.O. Savile. Mycologia 65: 268-270.

Murray, D. F. 1981. The Arctic and Antarctic: their division into geobotanical areas, by V. D. Alexandrova. Bioscience 31:153.
Murray, D. F. 1983. Arctic and Alpine Mycology, G. A. Laursen and J. F. Ammirati, eds., Quart. Rev. Biol. 58: 566.
Murray, D. F. and B. M. Murray. 1983. Tundra Ecosystems, L. C. Bliss, O. W. Heal, and J. J. Moore, eds., Bryologist 86: 401-402.
Murray, D. F. 1986. Beringia in the Cenozoic Era, V.L. Kontrimavichus, ed. Science 232: 533.
Murray, D. F. 1997. Flora of the Yukon, W. J. Cody. Syst. Bot: 22: 596-597.

Small Mammal Inventory

John Burch (Principal Investigator)

Wildlife Biologist – Yukon-Charley Rivers National Preserve, 201 First Ave., Fairbanks, AK 99701. 907/456-0505 (phone), 907/456-0452 (fax), John_Burch@nps.gov (e-mail).

John Burch's expertise is with large mammals, primarily wolves, moose, caribou, Dall's sheep and bears. He participated in small mammal trapping efforts in Bryce Canyon National Park (1994) as part of a larger study to determine the impacts and benefits of prescribed fire on the ecosystem. John also gained experience trapping small mammals in 2 different courses as an undergraduate in wildlife biology at the University of Minnesota in 1982. Skills John acquired in a mark-recapture course (1993) as a part of his graduate studies in wildlife biology at the University of Alaska Fairbanks, will aid in project design and analysis.

WORK EXPERIENCE:

8/96- present	Wildlife Biologist	Yukon-Charley Rivers National Preserve - Fairbanks, AK
4/94-8/96	Biological Technician	Bryce Canyon National Park – Bryce Canyon, UT
5/90-4/94	Wildlife Biologist	Denali National Park and Preserve - Denali Park, AK
10/85-5/90	Biological Technician	Denali National Park and Preserve - Denali Park, AK
5/83-10/85	Biological Technician	USFWS wolf research – Ely, MN
5/79-5/83	Biological Technician	Animal Damage Control (wolves) – Grand Rapids, MN

EDUCATION :

Master of Science (in progress), Wildlife Biology University of Alaska, Fairbanks – Planned for Feb. 2001
Bachelor of Science, Wildlife Biology - University of Minnesota, St. Paul – 1983

Shelli Swanson (Key Coworker)

Wildlife Biologist—Yukon-Charley Rivers National Preserve and Gates of the Arctic National Park and Preserve, 201 First Ave., Fairbanks, AK 99701. 907/456-0497 (phone), 907/456-0452 (fax), Shelli_Swanson@nps.gov (e-mail).

Shelli Swanson has worked as a biologist for the National Park Service in Alaska since 1990. Her main focus areas are nongame species (primarily birds and small mammals), furbearers, and physical resources. She is currently conducting the Servicewide I&M funded bird inventory project for YUCH in addition to serving as the Central Alaska Network Coordinator. She has conducted previous small mammal inventory work in western Minnesota in 1988 under the direction of Dr. Elmer Birney of University of Minnesota Bell Museum. She volunteered for the University of Alaska Museum (UAM) in 1989, putting up a variety of mammal specimens. From 1991-1994 she conducted a study of small mammal populations in different aged burns in the Kobuk Preserve Unit of Gates of the Arctic National Park and Preserve (GAAR). This project was a cooperative project with Kanuti National Wildlife Refuge and Koyukuk/Nowitna National Wildlife Refuge. Specimens and tissues were collected and housed at UAM from this project. Shelli also conducted a preliminary small mammal study in the Castle Mountain Unit of GAAR where 2 new small mammal species for the park where collected and vouchered. She has a Master's Degree in Wildlife from the University of Minnesota and a Bachelor's degree in Biology/Environmental Studies from Augustana College.

Selected References:

Swanson, S.A. 1996. Small mammal populations in post-fire black spruce (*Picea mariana*) seral communities in the upper Kobuk River Valley, Alaska. NPS Technical Report NPS/AFARBR/NRTR-96/30. 38 pp.

_____. 1997. Yellow-cheeked voles and fire along the upper Kobuk Valley, Alaska. Arctic Research 11; 45-49.

Freshwater Fish Inventory

Eric Veach (Principal Investigator)

Fishery Biologist. Wrangell-St.Elias National Park and Preserve. PO Box 439
Copper Center, AK 99573. eveach@nps.gov

Fishery Biologist, Wrangell-St. Elias National Park, **May 5, 2000 to Present**
Principal investigator for Abundance and run timing of sockeye salmon in Tanada Creek project.
Responsible for subsistence fishery monitoring, review of regulation proposals and assist the Superintendent with in-season management.
Work with tribal governments and community groups to develop fishery monitoring projects.

Zone Fishery Biologist, U.S. Forest Service, 10 years experience in 3 regions
Responsible for fishery program management, including supervision of up to 13 individuals and managing a $250,000 annual budget.
Performed Endangered Species Act consultation for 3 ESA listed fish species.
Developed and supervised a fish inventory program emphasizing ESA listed fish species.
Responsible for stream habitat inventory program on Prince of Wales Island, Alaska

Smolt Monitoring Project Leader (Fishery Biologist) for the Nez Perce Tribe 1 year
Supervised the Joseph, Oregon Nez Perce Fisheries Office.
Project Leader for a smolt trapping and PIT tagging project that estimated the survival of Imnaha River salmon smolts as they migrated through Snake and Columbia River hydroelectric dams.

B.Sc. in Fisheries Science at Oregon State University, Corvallis, Oregon.

Publications:

Veach, E.R. and D.C. Burns. 1998. Biological Assessment for the Potential Effects of Managing the Payette National Forest in the Deep Creek Section 7 Watershed on Snake River Spring/Summer Chinook Salmon and Snake River steelhead. Volume II: Ongoing Projects. Payette National Forest, McCall, Idaho.

Veach, E.R., M.Banach, A.Egnew, and D.C. Burns. 1998. Biological Assessment of the Potential Effects of Managing the Payette National Forest in the Weiser River Watershed on Columbia River bull trout. Volume I: Ongoing Activities. Payette National Forest, McCall, Idaho.

Personal Information:

Proud father of a 15 month old son
Enjoy flyfishing and flytying
Have successfully raised and bred a wide range of fish species in aquaria

Frederick M. Andersen (Key Coworker)

Fishery Biologist. Gates of the Arctic National Park, Denali National Park and Preserve and Yukon Charley Rivers National Preserve, 201 First Ave., Fairbanks, AK 99701.
Phone: 907/456-0451. Fred_Andersen@nps.gov

Education: B.S. Natural Resource Conservation, University of California at Humboldt

Experience: ADF&G Comm. Fish. Div., Yukon Area Mgmt. Biologist 1974-1989
ADF&G Sport Fisheries Div., Management Supervisor, 1989-1993
ADF&G Sport Fish Div., Regional Supervisor, 1993-1998
National Park Service Fisheries, Biologist, May 2000-present

Mr. Andersen has been a fishery biologist in Alaska since 1970. He first worked in Ketchikan as assistant area biologist for the Alaska Department of Fish and Game, Commercial Fisheries Division and was involved with the management of commercial and subsistence salmon and herring fisheries throughout in Southeast Alaska. In 1974, Fred relocated Fairbanks and assumed management responsibility for the subsistence salmon fishery and the developing commercial salmon fishery on the middle and upper portions of the Yukon River. In addition to having management and regulatory responsibilities, he designed and supervised several test- fishing projects and helped develop a number of escapement enumeration and other stock assessment projects throughout Interior and Western Alaska. From 1989 through 1993, he served as Management Supervisor for ADF&G Sport Fish Division and in this capacity was in overall charge for recreational fishery management programs in that part of Alaska north and west of the Alaska Range. During the last 5 years of his career with ADF&G, Fred was the Sport Fish Division Regional Supervisor for the Arctic-Yukon-Kuskokwim region and had overall responsibility for all recreational fishery research, stock assessment and management functions in Interior, northern and Western Alaska. Fred has worked as a Fishery Biologist in the Subsistence Management program since May, 2000.

APPENDIX II. PARK-SPECIFIC INVENTORY PROJECT DESCRIPTIONS FOR IDENTIFIED SPECIES OF SPECIAL MANAGEMENT CONCERN. These inventory projects were identified as high priority during the April Scoping Meeting but funding was insufficient to meet these needs.

List of Projects:

IA. Conduct an Assessment of Bryophyte and Lichen Biodiversity in the Central Alaska Network Parks.

IB. Prepare Annotated Bryophyte and Lichen Species Lists for the Central Alaska Network Parks.

IC. Distribution, Abundance and Habitat Associations of Furbearers in Yukon-Charley Rivers National Preserve.

ID. Distribution, Abundance and Habitat Associations of Furbearers in Denal National Park.

IE. Occurrence and Distribution of Amphibians in Wrangell-St. Elias National Park and Preserve.

IF. Distribution, Abundance and Habitat Associations of Alpine Breeding Birds in Denali National Park.

IG. Conduct Rare Plant Inventories in Wrangell-St. Elias National Park and Preserve.

IH. Develop Predictive Models for the Distribution of the Rare and Endemic Flora of Wrangell-St. Elias National Park and Preserve.

II. Conduct a Status Survey of the US Fish Wildlife Service Species of Concern *Cryptantha shackletteana* L.C. Higgins (Boraginaceae) in Wrangell-St. Elias National Park and Preserve.

IA. Conduct an Assessment of Bryophyte and Lichen Biodiversity in the Central Alaska Network Parks.

Mary Beth Cook, Botanist, Wrangell-St. Elias National Park & Preserve, Alaska.
Carl Roland, Plant Ecologist, Denali National Park & Preserve, Alaska.

Problem Statement

Bryophytes and lichens comprise a high portion of the biomass in the subarctic boreal and alpine communities within the Central Alaska Network parks, are an important indicator of biodiversity which has not yet been assessed for any of these parks, are important components of the subarctic ecosystem and are sensitive bioindicators. Very little work has been done to assess lichen and bryophyte diversity across the network as indicated by the work at WRST which is representative for the network. Barbara Murray collected lichens in the Chitistone Valley within WRST while surveying the vascular flora with David F. Murray in 1968 and Richard Scott recorded bryophytes and lichens occurring in his plots in Skolai Pass in his study of alpine communities in 1974. WRST park staff have collected and curated 562 bryophyte and lichen specimens representing 103 lichen and 116 bryophyte species. However, these collections are from a handful of sites within WRST and are mostly from plot work so that azonal habitats are not represented. An area the size of the three Central Alaska network parks with its diversity of ecoregions and plant communities is likely to have a high number of undocumented species. Documenting this component of biodiversity in the parks will clarify the classification of the vegetation communities in the park, enhance our understanding of the composition and histories of our floras and identify rare species and communities that need to be protected.

Project Description

Delineate habitats to inventory in the three parks; conduct an inventory of the major zonal and azonal habitats within the network; verify specimens, curate, enter into NPSpecies, ANCS+ and regional collection and taxonomic databases; prepare a report with recommendations on continued assessment and monitoring; and publish findings in a peer reviewed journal.

Project Measures/Results.--Report on the biodiversity of bryophytes and lichens in the Central Alaska Network, curated collections, completed taxonomic and collections databases, completed ANCS+ and NPSpecies databases and recommendations for inventory and monitoring.

Budget

Item	Details	Costs
GS11 Staff botanist WRST/DENA	Supervise completion of projects at all three parks, in consultation with specialists, design study, select sites	ONPS base
Contract lichenologist for field work	3 months field work x 3 years ($4800/month)	43,200
Contract bryologist for field work	3 months field work x 3 years	43,200
Lichenologist specimen identification/verification	2 months each year x 3 years	28,800
Bryologist specimen identification/verification	2 months each year x 3 years	28,800
2 field assistants	2GS9 x 6 pay periods x 3 years ($1993/pp)	63,776
Field per diem	60 days x 4 persons x 3 years x $20	14,400

Item	Details	Costs
Travel/lodging en route to parks & for project meetings	$400/year x 4 persons x 3 years	4,800
OAS costs	40K each year for 30 day helicopter contract or used for fixed wing access	120,000
Specimen & project curation and data entry into ANCS+	GS5: 8 pay periods ($1085/pp)	8,680
Data entry into NPSpecies	GS5: 4 pay periods	4,340
Data entry into regional taxonomic and collections databases	GS9 botanist: 4 pay periods ($1993/pp)	7,972
Curation materials		3,000
Publication costs for results in peer reviewed journal, digital products, park reports		6,400
Preparation of park reports	GS9: 6 pay periods (in consultation with specialists)	11,958
Preparation of publications	Specialists (4 months)	19,200
Total cost:		**408,526**

IB. Prepare Annotated Bryophyte and Lichen Species Lists for the Central Alaska Network Parks.

Mary Beth Cook, Botanist, Wrangell-St. Elias National Park & Preserve, Alaska.
Carl Roland, Plant Ecologist, Denali National Park and Preserve, Alaska.

Project Statement

Bryophytes and lichens comprise a significant portion of the biomass in the subarctic and alpine communities found within the three Central Alaska Network parks and are key components in the subarctic ecosystem. There has never been a comprehensive effort to assimilate our current knowledge of bryophytes and lichens or to assess their diversity within park lands. Natural resource studies at WRST in which lichens and bryophytes have been collected have resulted in the documentation of species new to the state as well the documentation of very rare species. The first step in assessing this component of the parks' biodiversity is to document current lists and make this information available to researchers so that a field inventory can be developed. YUCH and DENA have a backlog of specimens that have not been determined from previous resource studies, and WRST has 100 bryophytes from a recent forestry study that need to be curated. A preliminary bryophyte and lichen list has been prepared for WRST based on park collections but collections made by researchers prior to the park's creation have not been annotated, nor has this data been entered into our collections and taxonomic databases.

Project Description

Identify and curate the backlog of bryophytes and lichens at all three parks; compile and review literature documenting bryophyte and lichen occurrences in the three parks; prepare an annotated species list of bryophyte and lichens, and distribute this information on the internet and in publications.

Project Measure/Results.-- Published annotated moss and lichen species lists for all three parks, correctly determined voucher collections, updated collections and taxonomic databases with bryophyte and lichen distribution information, updated ANCS+, updated NPSpecies, recommendations for the development of a network inventory to assess bryophyte and lichen biodiversity.

Budget

Item	Details	Costs
GS11 Staff botanist WRST/DENA	Supervise completion of projects at all three parks	ONPS base
Specimen identification/verification	Contracted to specialists	7000
Specimen curation and entry into ANCS+	GS5: 8 pay periods ($1085/pp)	8680
Data entry into NPSpecies	GS5: 3 pay periods	3255
Data entry into regional taxonomic and collections databases	GS9 botanist: 2 pay periods ($1993/pp)	3986
Preparation of annotated species lists	GS9 botanist: 4 pay periods	7972

Item	Details	Costs
Preparation of species lists for the web	GS9 botanist: 1 pay period	1993
Curation materials		2000
Publication of annotated species lists in peer reviewed journal		3000
Total cost:		37886

IC. Distribution, Relative Abundance, and Habitat Associations of Furbearer Species in Yukon-Charley Rivers National Preserve.

Nikki Guldager, Biological Technician, Yukon-Charley Rivers National Preserve, Alaska.

Problem Statement

Yukon-Charley Rivers National Preserve's (YUCH) enabling legislation, the Alaska National Interests Land Conservation Act (ANILCA) requires the National Park Service (NPS) to manage all fish and wildlife within the preserve so that healthy and viable populations are maintained (Title II, sec. 202). ANILCA also requires NPS to provide for subsistence use of park resources by local residents, which includes trapping (Title VIII, sec. 802). Furbearers should be effectively managed according to YUCH's GPRA goal Ib03 (within the five-year strategic plan) that includes monitoring and protecting the health of consumptive use species. YUCH's General Management Plan declares that furbearer studies will be conducted with a concentration on marten and lynx. "Accurate population counts and trends will be established, and monitoring will be initiated to detect any threats to healthy and productive populations." (YUCH General Management Plan).

Furbearing species are fundamental to YUCH given their widespread distribution and past / present trapping efforts within the boreal ecosystem of the Yukon Valley. Trapping in the Preserve provides valuable subsistence opportunities and significant income for local residents. Fourteen species inhabit the Preserve; wolf, wolverine, lynx, marten, river otter, and beaver are of primary management interest (YUCH Resource Management Plan). Of these, marten and lynx are the most economically valuable and sought after by subsistence users. Marten are consistently economically valuable due to their local abundance and high trap success, and lynx are particularly sought after when cyclically abundant or during periods of high pelt prices. The preserves Resource Management Plan recommends that "… cooperatively testing and refining population survey techniques, and developing monitoring plans for at least three species (marten, wolves and lynx)" is one of the preserves priority efforts. Interagency cooperation is encouraged in the Resource Management Plan to develop survey techniques that will produce long term monitoring protocols and habitat use information. Development of effective population survey techniques and habitat analyses is critical in order to protect and maintain harvested species populations and insure informed management decisions.

Data on furbearer populations (with the exception of wolves) throughout the Preserve is negligible. Wolf telemetry studies have been ongoing since 1993, and have provided information on population abundance, demography, and predator / prey relationships. Marten population dynamics were studied via radio telemetry and carcass collection from 1990 – 1993 within a 38 km^2 study area along the Yukon River; the area encompassing Logan, Butte, and Dewey creek drainages. The Alaska Department of Fish and Game track furbearer harvest through sealing records. Within the two game management units that encompass the Preserve; lynx, wolves, wolverine, river otter and beaver require sealing. Sealing records represent the minimum harvest due to lack of local sealing agents, or because furs are home processed for personal use; annual trapping effort is not well documented. Trapping effort and species targeted vary in response to population trends and fur prices. Informal trapper interviews have indicated that harvest effort and success have fluctuated greatly in the past. Private development of inholdings, human population increases in adjacent communities, and increased access points may all affect trapping efforts in the future.

Project Description

The goal of this project is to develop and apply furbearer track survey techniques to YUCH in order to inventory and monitor species population trends and habitat use.

The following objectives were developed to meet this goal:

1. Work within interagency group to develop furbearer videography survey techniques, and adapt techniques to the terrain of YUCH.
2. Produce standard written protocols to be used by other parks.
3. Identify habitat associations of lynx, marten, fox and snowshoe hares.
4. Produce relative abundance and habitat distribution maps of lynx, marten, fox and snowshoe hares.
5. Provide an index to annual population abundance for monitoring purposes.

Track surveys of marten, lynx, fox and snowshoe hares will be conducted using aerial videography techniques. Annual track counts will provide an index to population trend, as well as provide animal locations for habitat selection analyses. Random transects will be placed across the landscape and will be flown at approximately 500 ft above ground level. High-resolution digital video footage will be taken from two camera ports in the belly of a Cessna 185. One camera will be set to full telephoto in order to produce high-resolution footage (10-meter swath on the ground), and a second camera will be set at a farther focal length in order to capture a landscape perspective for track and habitat identification. A Precise Lightweight GPS Receiver will be linked into the camera system so as to assign XY coordinates to each video frame. Visibility correction factors will be developed for different terrain and habitat types. Footage will be viewed in the office during which a database will be created that will include track species, location, days since snowfall and various habitat parameters. Observation time of track footage in the office is estimated to take three times that of the actual flight time. Surveys will be repeated every 3 years in order to monitor changes in population size, distribution and habitat selection.

This is a cooperative project with the Alaska Department of Fish and Game (ADF&G), U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS) and U.S. Geological Service-Biological Resources Division (BRD). ADF&G and WEST INC (through USFWS partnership) will provide statistical assistance in study design and analysis. Videography technological assistance will be provided by BRD. Park biologists will work closely with the cooperating experts to develop more detailed study designs, survey methods and technical protocols. Furbearer survey and analysis methods will be well documented in formal reports for easy implementation by other Parks. Annual reports of methods, results and conclusions will be completed.

Schedule.--Meetings were held by the interagency workgroup to discuss protocol development and to preliminarily test techniques in FY 2000. Initial YUCH test flights will be conducted in FY 2001 during early winter or spring using a USFWS outfitted plane and pilot that is experienced in flight techniques and equipment operation. This will determine YUCH flight and survey methods. Meetings will be held between project pilots in order to insure transfer of information, and the project leader will acquire technical skills in FY 2001.

In FY 2002, the preserve plane will be modified and outfitted with equipment. A complete spring track survey will be completed and correction factors will be developed the same year. Data processing and final products from the FY 2002 survey will be completed no later than FY 2003. Surveys will be completed every 3 years.

Budget

Once the initial equipment investment is made, correction factors are developed and techniques are fine-tuned, videography will provide a cost-effective method for monitoring furbearer populations.

Regular surveys following FY 2002 are estimated at $15,000. A summary of costs during the initial 2 years is presented in Table 1.

Table 1. Summary of costs for FY01 – 02 for the YUCH furbearer monitoring project.

EXPENDITURE	FY2001	FY2002
Videography Equipment		
2 cameras, 2 monitors, digital VCR		9500
connecting equipment and tapes	150	1800
video processing software		700
Plane Modification (OAS charge)		10000
Aerial Surveys		
40 hrs@ $125 /hr (DOI Cessna 185)	5000	
40 hrs fuel = 15 gal/hr @ $3.50 /gallon	2100	
50 hrs@ $125 /hr (DOI Cessna 185)		6250
50 hrs fuel = 15 gal/hr @ $3.50 /gallon		2625
Ground Surveys		
snow-machine fuel		500
Personnel		
GS-5 Bio-tech 320 hrs		8000
Travel /per diem	2500	1000
Miscellaneous supplies	250	500
ANNUAL TOTALS	10000	40875
TWO YEAR TOTAL	50875	

ID. Distribution, Abundance, and Habitat Associations of Furbearers in Denali National Park.

Gordon Olson, Chief, Research and Resource Preservation, Denali National Park and Preserve, Alaska

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Problem Statement

Mount McKinley National Park was established in 1917 to protect an outstanding assemblage of wildlife resources. While large mammalian species tend to receive a majority of the visitor interest and research and management attention, furbearers play an important role in the ecosystem of the park. Furbearer species inhabiting Denali are beaver (*Castor canadensis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), lynx (*Lynx canadensis*), marten (*Martes americana*), mink (*Mustela vison*), ermine (*M. erminea*), weasal (*M. rixosa*), muskrat (*Ondatra zibethicus*), river otter (*Lutra canadensis*), red squirrel (*Tamiasciurus hudsonicus*), ground squirrel (*Spermophilus parryii*), marmot (*Marmota caligata*), wolf (*Canis lupus*) and wolverine (*Gulo gulo*). This proposal addresses furbearers residing in the park, with the exception of wolves since they have been studied for many years.

Furbearers within the park continue to be naturally regulated although they are faced with a host of natural and anthropogenic influences with potential to affect population parameters and distribution. These include weather, predation, loss of habitat due to human development, and harvest. Park visitation has increased dramatically over the past two decades. Consequently, the potential for impacts to furbearer populations also increases as facility development expands and wildlife/human interactions increase. There is a need to understand the factors that influence furbearer population characteristics so that natural processes can be maintained and anthropogenic forces mitigated.

Furbearers are fully protected from harvest within the old Mount McKinley National Park boundary. Furbearers may be harvested under State and Federal regulations within the 1980 Alaska National Interests Lands Conservation Act (ANILCA) park and preserve additions to the park. Non-subsistence harvest regulations are developed by the Alaska Board of Game (BOG) while subsistence harvest regulations are developed by the Federal Subsistence Board (FSB). Limited harvest currently occurs, but at a level that would not likely affect population parameters. The difficulty in accessing these areas, and low fur prices, are expected to continue to limit interest in trapping. However, social and economic conditions could change quickly, which could result in greater interest in harvesting furbearers.

Very little is known about the furbearer populations of the park and preserve. Most wildlife research in Denali has focused on understanding large mammal predator-prey interactions and park management is currently unable to survey furbearers due to budget, personnel, and technical constraints. Interviews with local subsistence trappers have provided incidental information of furbearer abundance. Most furbearer population information is derived through furbearer harvest records. Additional information may also be derived through trapper interviews and questionnaires and pelt sealing records for species requiring sealing, such as lynx, river otter, wolverine and beaver. However, with trapping efforts declining, this rough index of local furbearer populations provides very little quantitative information.

Population information is very difficult to collect for most furbearer species. Furbearer population monitoring programs have proven to be extremely costly and have met with limited success. Examination of carcasses of trapped animals has been used to provide an index of population demography and productivity. However, this technique relies on consumptive practices, which are not allowed in the old park, and may not provide a large enough sample size in new park areas to determine population parameters during periods of low trapping effort. Trapper questionnaires have provided some of the best information on furbearers to date.

Track surveys have been proposed for some species. The State has conducted research on the efficacy of utilizing aerial track surveys to analyze relative abundance. However, track deposition after adequate snowfalls has proven to be highly variable. Aerial track surveys may provide a relative index for some species (marten, lynx, and wolverine) but it is not likely to provide a population estimate with enough precision to track population numbers other than in a gross context.

Beavers may be one of the few species that may be easily surveyed using existing techniques. Cache surveys during fall, prior to freeze up, will provide a number of active lodges. Caches are relatively easy to identify in most ponds, lakes, and streams. However, due to the remoteness of most beaver habitat, this work would require expensive aerial surveying of beaver occupied areas.

Project Description

Specific details regarding inventory methods have not been settled on at this point. One of the park's Wildlife Biologist positions is currently vacant. This position will have a major role in sorting out methodologies. The situation is further complicated by the fact that numerous species fall into this category of furbearers, and these species occur in low densities, and have large home ranges and elusive behavior in some cases. No single methodology will work for all species. Methodologies must be carefully thought out.

Estimates of relative abundance and descriptions of habitat associations will be developed for each species. Models for predicting suitability of habitat may be developed.

Budget

The budget will reflect salary, per diem, and transportation costs associated with fieldwork preparation, fieldwork, supplies and equipment, and data entry. Denali NPP will supply some equipment, ground transportation, data analysis, and report writing. The principal investigator for the project will be one of Denali's GS-12 biologists. The GS-12 biologist is responsible for analyzing data, developing models, and writing reports.

IE. Occurrence and Distrubution of Amphibians in Wrangell-St. Elias National Park and Preserve, Alaska.

Eric Veach, Fisheries Biologist, and Carl D. Mitchell, Wildlife Biologist, Wrangell-St. Elias National Park and Preserve, Alaska.

Problem Statement

Amphibians are a resource often neglected by managers. This is especially true in Alaska, where endemic species are few, and at the northern limit of their ranges (Hodge 1976). Amphibians are good indicators of overall environmental health. They contribute significant biomass to many aquatic ecosystems, play important roles in the trophic dynamics of wetlands, and are sensitive to habitat loss, climate change and environmental contaminants (Wyman 1990, Blaustein 1993). Many amphibian species appear to be declining worldwide, and efforts are underway to determine the causes and impacts of this phenomenon.

Little data on species distribution or populations of amphibians in Alaska. As a result, it is difficult for resource managers to monitor or make valid management decisions about potential impacts of recreation, mining, road development and other pressures on populations or ecosystems. Wrangell-St. Elias NP/P (WRST) is believed to host three species of amphibians, wood frog (*Rana sylvatica*), boreal toad (*Bufo boreas*) and Rough-skinned newt (*Taricha granulosa*), but little other information is available. Therefore, during April 2000 scoping meetings for the National Park Service's Inventory and Monitoring initiative in Anchorage, participants identified amphibians in WRST as species of special concern. This proposal was developed in response to that need.

Project Description

The three species currently present in WRST have different life histories, distribution and habitat requirements. No single technique is likely to suffice to detect and enumerate all three species. In addition, dedicated funds for these surveys are unlikely. Therefore in light of the general nature of the information need and realistic budgetary and logistical constraints, we propose to use existing field crews and support services (see Roland and Cook, and Burch, this document) to obtain inventory data on amphibians.

In conjunction with recognized experts, we will prepare materials with the following information on amphibian species known to occur in WRST: a photograph, diagrams with diagnostic characteristics highlighted (as *per* Petersen's Field Guides), pertinent life history data, habitat information from the published literature, and instructions for documenting occurrence, relative abundance, location, and habitat characteristics. These will be provided to all field personnel engaged in I&M activities in WRST, in addition to field data forms, cameras and film.

Since we have no information on abundance, physical specimens will be limited to those absolutely necessary for documentation purposes. Voucher specimens will be labeled and preserved in alcohol. Photography will be used to document species presence whenever possible.

For each sighting/specimen, data collected will include, date, observer(s), species observed, number observed, age (adult, neotonic, tadpole, larval, egg), general location (e.g. area, creek or wetland, distance and direction from nearest named landmark), specific location (PLGR lat-long), habitat classification (Viereck label IV), habitat description, photograph number and any other pertinent data (e.g. weather, other faunal associations).

Data forms will be returned to WRST (Veach), stored and archived as originals, entered into an EXCEL database, and imported into other NPS databases. At the end of the inventory period, all data will be summarized by species and a written report prepared and distributed.

Budget

The nature of this exercise limits our budget to staff time devoted to preparation of field data forms and other materials, film developing, data entry, archiving, and report preparation. These costs are estimated at $500-$1000, and will be borne by WRST.

Literature Cited

Blaustein, A.R. 1993. Declining amphibian populations in perspective. Park Science 13(4):8-9.

Hodge, R.P. 1976. Amphibians and Reptiles in Alaska, The Yukon and Northwest Territories. Alaska Northwest Publishing Co., Anchorage. 89 pp.

Wyman, R.L. 1990. What's happening to the amphibians? Conservation Biology 4(4):350-352.

IF. Distribution, Abundance and Habitat Associations of Alpine Breeding Birds in Denali National Park.

Carol McIntyre, Wildlife Biologist, Denali National Park and Preserve, Alaska

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Problem Statement

This study seeks to develop a landscape level approach to understanding the distribution, abundance, and habitat requirements of birds breeding in alpine areas within Denali National Park and Preserve (Denali NPP). A major goal of this project is to understand which environmental factors affect the distribution and abundance of alpine breeding birds and to predict, based on our results, further distribution and abundance of these species in Denali. Alpine habitats support a variety of breeding birds in Alaska's National Parks and Preserves. Many of these birds including Baird's Sandpiper, Surfbird, Long-tailed Jaeger, American Golden Plover, and Northern Wheatear are long-distance migrants that spend their breeding seasons in Alaska then travel thousands of kilometers to their wintering grounds. The breeding habitat requirements of these species seem to be rather specific and maintenance of these areas is of utmost importance for the long-term viability of many species. However, quantitative assessments of the habitat requirements for many of these species in interior Alaska are lacking. Further, most of these species build their nests on the ground where they are vulnerable to predation and to unintentional human disturbance. Additionally, alpine areas may be sensitive to changes in climatic conditions. Denali NPP is currently addressing issues associated with new access corridors, new visitor facilities and increased backcountry use. Denali NPP is also addressing global issues that affect park resources including persistent organic pollutants and climate change. All these issues have the potential to impact alpine breeding birds and their habitat in Denali. Baseline information on the distribution and abundance of wildlife and their habitat is necessary to protect these park resources from both anticipated and unanticipated impacts. Information on the distribution, abundance, and habitat requirements of alpine breeding birds generated through this project would be valuable for Denali's planners as they develop regulations for protecting park resources. This information is also valuable for gaining a better understanding of the habitat requirements of alpine breeding birds in interior Alaska.

Project Description

Selecting sampling areas.--We are proposing two modes of sampling depending on funding levels. The preferred sampling design, randomly selected areas meeting our criteria within Denali NPP, requires transportation via helicopter to most sampling sites. This is the more expensive sampling design because of the costs associated with flight time. It is also the more robust option since it allows us to make statistical inference over a larger area (all alpine areas in Denali). The alternate sampling design, randomly selected areas within a day's walk of the Denali Park road, George Parks Highway or Petersville Rd., relies on foot travel. The alternate sampling design would limit our scope of statistical inference to alpine areas within a day's walk of roads in and near Denali NPP. We are setting a minimum sampling area requirement of 36-sq. km. for each sampling area. The actual size of the sampling area is dependent up the areas that meet our sampling criteria: areas between 3500 and 5000' ASL, areas not covered by glaciers or rock cliffs, and areas that do not include large patches (> 10 ha) of shrubs. We will use ArcView GIS software to delineate areas in Denali that meet these criteria and to select three sampling areas on the north side and south side of the Alaska Range (n = 6 sampling areas).

Sampling techniques.--We will develop estimates of relative abundance, describe distribution and develop predictive multivariate models using data collected via standardized line transects. Line transect methodology offers an efficient method for surveying birds in open landscapes such as alpine habitat because these areas are relatively easy to travel over by foot and alpine breeding

birds are relatively easy to detect in this open habitat. A random sample of four transects will be selected in each sampling area following methods described by Thompson (1992). A straight baseline of length *B* will be drawn across the sampling area. The length of the baseline will be the width of the sampling area. A random sample of six transect locations will be selected from the uniform distribution on the interval (0,*B*), however no transect will be within 400 meters of another. Transect lines will be perpendicular to the base line and will be located through each selected point. There is zero probability of selecting the same transect twice since transect locations will be selected from a continuous distribution.

We will establish four transects, 6 km in length and 100 meters wide (50 m both sides of the transect) in each sampling area. Observers will move along the transect line at approximately 1 km per hour surveying birds along the entire transect. Surveys will start at approximately 0400 and end by 1200 each day. A single observer will survey for birds along the entire transect. A second observer will record all data on standardized field data sheets. Observers will alternate between transects to minimize observer bias. The observer will identify all detected birds to species and estimate the horizontal distance from the observer to the bird. Distances will be checked using a laser range finder. Vegetation communities and a series of habitat attributes (including slope, aspect, and elevation) will be recorded along each transect and for each observation. All data will be recorded on field data sheets and entered into a computerized database. We will survey each transect twice per year (once in late May/early June and once in late June/early July) for two years to examine temporal variation in detection of birds during the breeding season and relative abundance between years. While this sampling strategy limits the number of sampling areas we visit, it should allow us to develop robust habitat models, examine temporal variation in detection rates of alpine birds, and examine estimates of relative abundance between years.

Products.--We will develop a series of multivariate models to estimate the probability of detecting alpine breeding birds in suitable habitat in Denali NPP, quantitatively describe habitat associations for individual species, and develop predictive models based on presence of individuals as response variables and a series of environmental variables as explanatory variables. The predictive models will allow Denali managers and planners to use their desktop computers to locate known and potential breeding habitat for individual species of alpine breeding birds in Denali. We will generate estimates of relative abundance using Program DISTANCE software. Estimates of relative abundance will be valuable for identifying areas that are particularly important to alpine breeding birds.

Budget

The budget reflects salary, per diem, and transportation costs associated with fieldwork preparation, fieldwork and data entry. Denali NPP will supply equipment, ground transportation, data analysis, and report writing. Our budget represent total costs with and without helicopter use.

The principal investigator for the project will be one of Denali's GS-12 biologists. One GS-09 field biologist and one GS-05 wildlife technician will conduct fieldwork.
A team of one GS-09 biologist and one GS-05 biological technician will conduct the surveys. The GS-09 is responsible for preparing gear for fieldwork and completing data entry and data proofing at the completion of each year. The GS-12 biologist is responsible for analyzing data, developing models, and writing reports.

Item	**Details**	**Annual Cost**	Total
Personnel			
GS-12 Wildlife Biologist	Provided by Denali		
GS-09 biologist	6 pay periods per year @ 1831 per pay period	10,986.00	21,972.00
GS-05 technician	5 pay periods per year @1085 per pay period	5,425.00	10,850.00
Per Diem	50 days @ 19 per day per person	1,900.00	3,800.00
Transportation	12 helicopter shuttles @ 1000.00/shuttle	12,000.00	24,000.00
Total cost w/ helicopter shuttles	**Preferred sampling design**	**30,311.00**	**60,622.00**
Total cost w/o helicopter shuttles	**Alternate sampling design**	**18,311.00**	**36,622.00**

IG. Conduct Rare Plant Inventories in Wrangell-St. Elias National Park and Preserve.

Mary Beth Cook, Botanist, Wrangell-St. Elias National Park and Preserve, Alaska.

Problem Statement

There are 74 rare plant taxa and 443 occurrences in the park. Five of these species are either critically imperiled or imperiled globally (Alaska Natural Heritage Program global rank of one or two), whereas 23 species are critically imperiled in the state.
Information from our 1994-1997 survey contributed to taking four species off of the rare plant list for the state and added eight to the list that were unknown previously from the state. This survey did not focus on rare plant habitat and was not comprehensive for the park (see figure A3). The inventory being funded out of the current Inventory & Monitoring initiative will not focus on rare plant habitat.

Rare plants are important indicators of biodiversity and of the history and composition of an area's flora. Those species that are rare to the state should receive special protection in our parks since they represent a unique genetic resource that we have yet to assess. Knowing the distribution of the rare plants in the park will help us in our visitor use planning and in developing a monitoring program of vital signs.

Project Description

Using models developed from collection data acquired during the 1994-1997 inventory of the park's flora, conduct targeted inventories of potential rare plant habitat in order to assess the extent of these populations globally and in the state. Curate collections, enter data into collections and taxonomic databases, ANCS+ and NPSpecies, prepare a rare plant GIS theme, make recommendations for monitoring rare plant populations in the park and publish findings in a peer reviewed journal.

*Project Measure/*Results.-- Identification of rare plant distributions in the park; report and publications documenting the findings; data layer in Arcview; recommendations for monitoring; recommendations for visitor use planning; information exchange with the Alaska Natural Heritage Program and the University of Alaska Fairbanks Museum;

Budget

Item	Details	Costs
2 Contract botanists	4 ten day surveys each summer for 3 summers; includes specimen determination and report; $7,200 each survey	172,800
GS11 park botanist	Site selection, project oversight, completion of final products	ONPS
2 field assistants	2GS9 x 8 pay periods x 3 years ($1993/pp)	95,664
Field per diem	60 days x 4 persons x 3 years x $20	14,400

Item	Details	Costs
OAS costs	40K each year for 30 day helicopter contract or used for fixed wing access	120,000
Specimen & project curation and data entry into ANCS+	GS5: 8 pay periods ($1085/pp)	8,680
Data entry into NPSpecies & data exchange with AKNHP	GS5: 4 pay periods	4,340
Data entry into regional taxonomic and collections databases; preparation of GIS data layer and data browser	GS9 botanist: 8 pay periods ($1993/pp)	15,944
Curation materials		3,000
Publication costs for results in peer reviewed journal, digital products, park reports		6,400
Preparation of park reports	GS9: 6 pay periods (in consultation with specialists)	11,958
Total cost:		**280,386**

IH. Develop Predictive Models for the Distribution of the Rare and Endemic Flora of Wrangell-St. Elias National Park & Preserve.

Mary Beth Cook, Botanist, Wrangell-St. Elias National Park & Preserve, Alaska.

Problem Statement

During an inventory of the park's flora, 74 rare and 24 endemic species were found. 228 sites within 13.2 million acres were surveyed in a reconnaissance approach. The inventory is far from complete, but provides an indication of where the endemic and rare plants are most likely to occur. Modeling would make it possible to quantify and to predict the distributions, would allow us to focus our survey efforts and would assist in the preparation of Environmental Assessments, cumulative impact studies and visitor use planning.

Project Description

Using collection and associated community data acquired during the 1994-1997 inventory of the park's flora, develop models which would predict the distribution of the rare and endemic flora within the park. Parameters such as slope, aspect, elevation, lithology, ecoregion and associated species, would be used to develop a model for each of the 74 rare plant species occurring in the park. The model would be used to generate expected distribution maps for each species and to prioritize inventory efforts and protection needs where distributions overlap.

Project Measure/Results.-- Maps with predicted ranges of rare and endemic plants; a report and publication documenting the findings with recommendations for protected areas and survey priorities; an increased ability to conduct field surveys for environmental assessments, and an increased ability to assess impacts of projected visitor use patterns.

Budget

Item	Details	Costs
GS11 botanist/GIS specialist	12 pay periods ($2411/pp)	28,932
Materials and supplies		1000
Publication costs		3000
Total cost:		**32,932**

II. Conduct a Status Survey of the US Fish and Wildlife Service Species of Concern *Cryptantha shackletteana* L.C. Higgins (Boraginaceae) in Wrangell-St. Elias National Park & Preserve.

Mary Beth Cook, Botanist, Wrangell-St. Elias National Park and Preserve, Alaska.

Problem Statement

A new population of *Cryptantha shackletteana* was found in the park in 1996. This plant is known from only two other localities world-wide and is closely related to a species in the Rocky Mountains. It is a USFWS Species of Concern and is critically imperiled globally and in the state of Alaska. There is potential habitat in the park and in adjacent Tetlin National Wildlife Refuge which should be surveyed for additional populations so that management recommendations for its protection can be made.

Project Description

Survey the Mentasta and Nutzotin Mountains in the park and adjacent Tetlin National Wildlife lands for additional populations of this globally rare endemic plant. Determine the abundance and distribution of known populations. Prepare a status report with recommendations for monitoring and assessment.

Project Measure/Results.--A status report on the distribution of *Cryptantha shackletteana* in Alaska with recommendations for research, monitoring, assessment and protection.

Budget

Item	Details	Costs
Contract for status survey and report with botanists from University of Alaska, Fairbanks Museum		20,000
OAS costs		10,000
Total cost:		**30,000**

APPENDIX III. DESCRIPTION OF PREVIOUS VASCULAR PLANT SURVEYS IN THE CENTRAL ALASKA NETWORK.

Denali National Park and Preserve

The focus of almost all of the past botanical collecting in DENA has been confined to the park road corridor. Until the past two years, there has never been a systematic effort to conduct a comprehensive inventory of the vascular flora of this area. Botanical work in the park has been sporadic through time, with little standardization in the objectives and methods of workers. Nevertheless, numerous important collections have been made in the park over the years that, taken together, have resulted in the compilation of a good survey of the flora in the park road corridor.

Brief History of Plant Collecting in Denali.--The first substantial plant collection in the area of the park was made by Ynès Mexia in 1928. She collected 365 numbers in the road corridor area of Mt. McKinley National Park. She traveled as far west as Wonder Lake and collected in the Wonder Lake, Mt. Eielson, Thorofare, Teklanika and Savage River areas, as well as in the vicinity of park headquarters. These specimens were deposited in the Herbarium of the University of California at Berkley. Other early collectors in the vicinity included Olaus and Margaret Murie in 1923 (specimens in the National Herbarium), and Edith Scamman in 1936 and 1937 (specimens in Gray Herbarium at Harvard).

Prior to the inventory effort of the past three years, the most significant and substantial plant collections in the area were made by the following teams of botanists:

- Dr. Aven and Ruth Nelson from the University of Wyoming collected nearly 1000 numbers in the park and adjacent areas of Broad Pass and the Susitna River valley in 1939.
- Harold and Virginia Bailey collected 600 specimens in the park and adjacent areas of Broad Pass and the Susitna River valley in 1950. A set of these specimens was deposited at the park with a duplicate setarchived in the Herbarium at U.C. Berkeley.
- Dr. Les Viereck has collected more than 1100 specimens in diverse areas around Denali National Park, starting in the early 1950's. His collection sites include the upper Kuskokwim River drainage, Muldrow glacier, Mt. Eielson, Dry Creek north of the Range, Windy Creek near Cantwell, Wonder Lake and other lowland sites in the west end of the road corridor.

Numerous other collectors have contributed to our knowledge of the flora of DENA including park staff (Steve Carwile), and outside researchers (including George Argus, Carolyn Parker, Galen Smith and others). In all, there were approximately 2000 vascular plant specimens known from the Park and over 3000 from adjacent areas outside of the park in 1998. These records have been assembled into a geo-referenced collection database that allows us to examine the distribution of plant inventory localities on the landscape (see Figure 1 in body of study plan). The spatial limitations of past inventory efforts become quite clear upon examination of this information.

R*ecent plant inventory efforts in Denali National Park and Preserve.*--In early 1998, the park botanist laid the groundwork for a targeted floristic inventory by analyzing existing botanical information and generating a list of species expected to occur in the park that were not documented as occurring there (Roland 1998). Computer databases initially developed as part of the Wrangell-St. Elias Floristic Inventory project were significantly expanded to include the known and expected flora of DENA. Taxonomic, distribution, and habitat information about the known and expected vascular plant species for DENA was entered into these databases. An examination of these data proved to be a very useful tool for targeting the limited available funds for inventory fieldwork. In just eleven days of fieldwork during the summer of 1998, 78 plant species new to the park were documented through vouchers (an 18 percent increase in the total number of species for the park; Roland 1998).

The Denali National Park floristic inventory project was continued with support from the NPS Servicewide Inventory and Monitoring Program in 1999. New vascular plant collections made in 1999 documented the presence of 74 species and nine subspecies, new to the park plant list. In addition, plant collections from the Denali Soils Inventory project contributed vouchers for 15 new species to the park plant list. There was an increase of 89 species in the flora of DENA resulting from 1999 fieldwork (and 101 new taxa, including subspecies). This number, combined with the 78 species added to the park flora in 1998, represents a cumulative increase in the park vascular plant list of 167 species (or about 36 percent over the pre-inventory number) for the period 1998-9.

Field inventory efforts in 1998-9 were primarily focused on sites on the south side of the Alaska Range in DENA (see Figure 1 in body of study plan). The primary objectives of site selection for this project were to inventory previously unstudied areas and to maximize the collection of species new species to the Park flora. We have documented the presence of 35 percent of the approximately 400 taxa on the original expected plant list. In addition, we have documented the presence of more than 30 species not originally expected to occur in DENA because these collections represented major extensions of the species known ranges.

Wrangell-St. Elias National Park and Preserve

Historical Collections.--Prior to the establishment of WRST in 1980, nine significant botanical surveys of areas within the park had been conducted: Hamilton L. Laing in 1925 at the head of the Chitina River (Hulten 1941-1950, Porsild 1939); David F. and Barbara Murray from 1966-1981 at Chitistone Pass, Skolai Pass, Guerin Glacier, Russell Glacier and Sheep Glacier (Murray 1968, 1971); Richard W. Scott at Skolai Pass, Frederika Glacier, Chitistone Pass and Snag Glacier in 1967 and 1968 (Scott 1968) and Olle Nordell and Alf Schmitt at Kennecott and Bonanza Ridge in 1967 (Nordell and Schmitt 1977). There were an additional three historical collections with more than ten specimens each from various localities (William L. Poto along the Mt. Drum trail in 1902; Frank Charles Schrader and G.H. Hartman between the Nabesna and Copper Rivers in 1902, and David W. Eaton from 1909 to 1913 along the Yukon border) and eighteen collections with fewer than ten collections each. These collection localities were mapped and entered into the Park GIS (Figure 2 in body of study plan)

Park Collections.--Park collections from 1980 - 1994 documented 585 of the 708 taxa known to occur in the park in 1994. Of the 1145 collections made prior to 1994, 594 (52%) were made by FIREPRO staff at 187 unique localities from 1984 to 1992 during a vegetation mapping project. The remaining collections were made during a bison range condition study (Miquelle 1985), mining compliance surveys (Cook 1987, 1988a, 1989a-c, 1990a-e, 1991a-c), a caribou range study (Jenkins, et. al. 1993) and a successional study on Guyot Glacier in Icy Bay (Beck 1989). None of these pre-inventory collections were from comprehensive surveys of the sites.

All vascular plant collections in the park herbarium were sent to the University of Alaska Fairbanks Museum (ALA) for verification in 1990 and 1991 and subsequent collections were sent to ALA for verification. Vascular and non-vascular plant species lists for the park were maintained beginning in 1988 (Cook 1988, 1990e, 1991d, 1992a-c). These lists compiled data for vouchered specimens in the park herbarium with published references. Rare plant lists (1992d), a rare plant field guide (Duffy and Cook 1992) and a list of range extensions (Cook 1989d,1991e) were also compiled and maintained.

1994-1997 Vascular Plant Inventory.--A vascular plant inventory of selected areas north of the Bagley ice field was funded by the Natural Resource Preservation Program (NRPP) from 1994-1997 (Cook 1993). We surveyed 239 sites focusing on areas of high endemism, sites with unique lithology (limestone, basalt, ultramafic and areas of hydrothermal alteration), unusual landforms

(sand dunes, warm springs, nunataks and cinder cones) and azonal communities (S-facing bluffs, wetlands and scree slopes; see Figure 2in body of study plan for map of sites).

This study resulted in the addition of nine species to the flora of Alaska and 172 species to the flora of the park, representing a 20% increase in the number of species for the park. Sixty-two (39%) of the additions to the park's flora were found in the last year of the survey indicating that the species area curve for the park has yet to level. Of the 7000 specimens collected and critically examined, 4167 were curated into the WRST herbarium for a total of 5473 vascular plants in the WRST herbarium documenting 880 taxa.

Thirty-nine species are unverifed by vouchers and there are an additional 219 taxa that are expected to occur in the park based on adjacent floras for a total of 258 expected species. Fifty-four of the expected species are non-native.

Products from this inventory pertinent to this proposal include:

- A relational database containing taxonomic, biogeographic and ecological attributes for 1114 species that are known to or are expected to occur in the park linked to collections and site databases.
- 200 park and regional (Alaska-Yukon Territory) distribution maps of notable finds.
- Curation of the collection into the NPS ANCS+ database and park herbarium
- Publication of significant collections, preparation of a rare plant field guide and a report documenting the results of the inventory (Roland and Cook 1998, Cook and Roland, in prep.)
- Data from rare and endemic plant collections are being used to develop habitat models for compliance activities.

The inventory at WRST is significant because it was the first systematic plant inventory in Alaska to assess such a large region. The groundwork for the Central Alaska Network inventory effort was established through this inventory by developing protocols for data entry and data exchange with both the University of Alaska Museum Herbarium (ALA) and Alaska Natural Heritage Program (AKNHP). We have also created the GIS framework for distribution map preparation, and a protocol for importing large amounts of data into ANCS+ and the ALA curation database. The analysis of cost effectiveness of various types of survey methods was also made possible through this project.

Yukon-Charley Rivers National Preserve

The Alaska Natural Heritage Program has assembled a database of vascular plant species that are present or expected in Yukon-Charley Rivers National Preserve. Most of these data have been georeferenced and mapped using GIS (see Figure 3 in body of study plan). It is clear that most of these collections are from the major river corridors where access is relatively easy compared to that for upland areas. However, there are additional plant collections that we are still in the process of assembling. A thorough review of the existing plant inventory information will be made as part of the preinventory process for YUCH, including detailed documentation of historical collections.

Literature Cited

Beck, Katy. 1989. Icy Bay glacial succession monitoring progress report. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. report. 44 pp.

Busing, R., Rimar, K., Stolte, K.W., Stohlgren, T. J. and K. Waddell. 2000. Forest Health Monitoring Vegetation Pilot Field Methods Guide: Vegetation Diversity and Structure, Down Woody Debris, Fuel Loading, May 2000. National Forest Health Monitoring Program, Research Triangle Park, North Carolina.

Clague, J. J. 1991. Quaternary Glaciation and Sedimentation, Chapter 12. *In* Geology of the Cordilleran Orogen in Canada. H. Gabrielese and C.J. Yorath (eds). Geological Survey of Canada, Geology of Canada. 4:419-434.

Clark, Mark. 1997. Draft Ecoregion subsections map for Denali National Park and Preserve, National Resource Conservation Service, Alaska Region.

Cook, Mary Beth. 1988a. Herbarium species list, Wrangell-St. Elias National Park and Preserve, Alaska. Unpub list. 10 pp.

_____. 1988b. Sudden Stream waste site vegetation survey and sampling. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. Report. 21 pp.

_____. 1989a. Vascular plant range extensions from Wrangell St. Elias National Park and Preserve, Alaska. Unpub. lists. 11 pp

_____. 1989b. Rambler mine site plant species list, Nabesna District. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list. 2 p.

_____. 1989c. Green Butte mine site and McCarthy Creek access route plant species list, Chitina District. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list. 4 pp.

_____. 1989d. Kotsina Road, Silver Star and Pandora mine sites plant species lists, Sanford District. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list. 4 pp.

_____. 1989e. Icy Bay mine site plant species list, Wrangell-St. Elias National Park and Preserve, Alaska. Unpub
list. 2 pp.

_____. 1990a. East Sitkagi Bluffs proposed mine site plant species list, Yakutat District, Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list. 2 pp.

_____. 1990b. Plant species list, Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list 18 pp.

_____. 1990c. Field Survey of Icy Bay mine site, Yakutat District. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. Report. 11 p.

_____. 1990d. Fountain Stream proposed mine site plant species list, Yakutat District. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list. 1 p.

_____. 1990e. Monitoring report for access to mine claims in the Gold Hill area in Wrangell-St. Elias National Park and Preserve Alaska. Unpub. Report. 131 pp.
_____.. 1991a. Rex Creek reclamation three year progress report. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub report. 13 pp.

_____. 1991b. Dan Creek plant species list, Chitina District, Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list. 2 pp.

_____. 1991c. Orange Hill Plant species list. Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. list. 2 pp.

_____. 1992. Rare plants of Wrangell-St. Elias National Park and Preserve, Alaska. Unpub. Report. 2 p.

_____. 1993. Vascular floristic inventories of selected areas within Wrangell-St. Elias National Park and Preserve. Natural Resource Preservation Program Project Proposal. Unpublished document. Natural Resource Division files, Wrangell-St. Elias National Park and Preserve. 11 pp.

____. 1994. Progress report for vascular plant inventory within Wrangell-St. Elias National Park and Preserve. Unpub. Report. 15 pp.

_____. 1995. Progress report for vascular plant inventory within Wrangell-St. Elias National Park and Preserve. Unpub. Report. 20 pp.

_____. 1996. At the crossroads, a vascular floristic inventory of Wrangell-St. Elias National Park and Preserve. Poster presented at the George Wright Society Meeting in New Mexico in 1996.

_____. 1999. History of botanical collecting within Wrangell-St. Elias National Park and Preserve. Chapter 2, 101 pp. In: A vascular plant inventory of selected sites north of the Bagley Ice Field within Wrangell-St. Elias National Park and Preserve. Report in progress.

_____ and Carl Roland. A vascular plant inventory of selected sites north of the Bagley Icefield within Wrangell-St. Elias National Park and Preserve, Alaska. Report in progress. 60 pp.

_____ and Carl Roland. Notable vascular plants from Wrangell-St. Elias National Park and Preserve, Alaska. Article in progress for the Canadian Field Naturalist.

_____ and Carl Roland. A field guide to the rare vascular flora of Wrangell-St. Elias National Park and Preserve. Publication in progress. 152 pp.

_____ and Peter Neitlich. 2000. Preliminary planning matrix for plants prepared for the NPS Alaska Region I & M plant working group. Unpub. document.

de Laguna, Frederica. 1972. Under Mout Saint Elias : The history and culture of the Yakutat Tlingit. Smithsonian Contributions to Antrhopology No. &. Washington : Smithsonian Institution Press.

Denton, G. H. 1974. Quaternary Glaciations of the White River Valley Alaska, with a Regional Synthesis for the Northern St. Elias Mountains, Alaska and Yukon Territory. Geol. Society of America Bulletin 85: 871-892.

Duffy, Michael and Mary B. Cook. 1992. Rare plants and range extensions from the Wrangell-St. Elias Area. Unpub. Report. 34 pp.

Gallant, A.L., E.F. Binnian, J.M. Omernik and M.B. Shasby. 1995. Ecoregions of Alaska. U.S. Geoglogical Survey Professional Paper 1567. Washington, D.C.: United States Government Printing Office. 73 pp.

Goff, F.G., G.A. Dawson, and J.J. Rochow. 1987. Site examination for threatened and endangered plant species. Environmental Management. 6:307-316.

Hamilton, T. D. 1994. Late Cenozoic glaciation of Alaska, Chapter 27 in Pflafker, G. and H. Berg (eds.) The Geology of Alaska: Geological Soc. of America, The Geology of North America v.G-1. Boulder, Colorado. pp. 813-844.

_____ and R.M. Thorsen 1983. The Cordilleran Ice Sheet in Alaska. Chapter 2 *In* H.E. Wright (ed) Late Quaternary Environments of the United States, Vol. 1, The Late Pleistocene. Minneapolis, MN: Univ. of Minnesota Press. pp. 38-52.

Jenkins, Kurt. J., Mary B. Cook, Patti J. Happe and Lindsey C. Christensen. 1993. Monitoring Vegetation Trends on the Mentasta Caribou Range, Wrangell-St. Elias National Park and Preserve. WRST Research and Resource Management Report 97-1. 69 pp.

Hopkins, D. M. 1967. The Bering Land Bridge. Palo Alto, CA: Stanford University Press. 495 pp.

Hulten, E. 1941-1950. Flora of Alaska and the Yukon. 10 Vols. Lunds University. 1902 pp.

Martin, S. 2000. Tourism and recreation in Southcentral Alaska: patterns and prospects. Paper given at the 51st Arctic Science Conference in Whitehorse, Canada, September 21-24 2000.

Miquelle, D. 1985. Food Habits and Range Conditions of Bison and Sympatric Ungulates on the Upper Chitina River, Wrangell-St. Elias National Park and Preserve. National Park Service, Alaska Region. Research/Resources Management Report AR-8.

Murray, D.F. 1968. A plant collection from the Wrangell Mountains, Alaska. ARCTIC. Journal of the Arctic Institute
of North America. 21:106-110.

_____. 1971. Notes on the alpine flora of the St. Elias Mountains. ARCTIC. Journal of the Arctic Institute of North America. 24(4):301- 304.

Nelson, J.R. 1987. Rare plant surveys: techniques for impact assessment. In: T.E. Elias (ed). Conservation and Management of Rare and Endangered Plants, Proceedings from a Conference of the California Native Plant Society. Sacramento: The California Native Plant Society. 630 pp.

Nordell, Olle N. and A. Schmitt. 1977. Botanisk inventering i Wrangell Mountains, Alaska. Lunds Universitat. 35 pp.

Parker, C. and D. Murray. 1992. Collecting Voucher Specimens for Documentation. Unpublished report prepared for the Alaska Rare Plant Working Group. University of Alaska, Fairbanks.

Porsild, A.E. 1939. Contributions to the flora of Alaska. Rhodora. XII:141-301.

Roland, Carl A. and Mary B. Cook. 1998. A notable range extension for the globally rare endemic plant, *Cryptantha shackletteana* L.C. Higgins, in East-central Alaska. 1998. Canadian Field Naturalist 112(1):158-160.

Roland, Carl A. 1998. Floristic Inventory of Denali National Park and Preserve project annual report. 13 pp.

Roland, Carl A. 1999. Floristic Inventory of Denali National Park and Preserve project annual report. 24 pp.

Russell, Israel C. 1891. An expedition to Mount St. Elias, Alaska. National Geographic Magazine. Vol . 3:53-204.

Scott, R. 1968. Vascular Plants of the Chitistone Pass Area, Alaska. High Mountain Environment Project, Arctic Institute of North America. Technical Report No. 2. University of Michigan. 18 pp.

Swanson, David. 1999. Ecological units of Yukon-Charley Rivers National Preserve, Alaska. YUCH Technical Report 99-001.

Teare, K. 1984. Standard Operating Procedures for Collecting Plant Specimens and Curating the Park herbarium. Unpublished report. Wrangell-St. Elias National Park and Preserve. 20 pp.

Viereck, L.A, C.T. Dyrness, A.R. Batten and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. RNP-GTR-286. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station, 278 pp.

APPENDIX IV. PARK-SPECIFIC TARGETED AREAS AND HABITATS FOR PLANT INVENTORY WORK IN THE CENTRAL ALASKA NETWORK.

Denali National Park and Preserve

Geographic gaps.-- We determined that there are only limited areas of DENA for which there are substantial existing floristic data (Figure 2 and Table A1). Past plant collections in the park were heavily concentrated in a few subsections within the Alaska Range ecoregion (in areas adjacent to the park road). The following subsections within the Alaska Range ecoregion contain relatively large numbers of collection localities: Interior mountains and valleys, High mountains, Front range and southern areas of the Kantishna Hills subsection. The targeted floristic inventory project that has occurred over the past two years has reduced the strong geographic and ecological biases of previous plant collection efforts in DENA. This was achieved by concentrating inventory fieldwork in "data gap" areas south of the Alaska Range crest and in under-represented habitats such as wetlands (Figure 2, Table A1; Roland 1998, & Roland 1999).

The results of the examination of preexisting floristic data allowed us to make the initial identification of the highest priority ecoregion subsections for floristic inventory work. High priority areas include all four subsections of the Kuskokwim Ecoregion within the park and the Toklat basin subsection of the Alaska Range Ecoregion. Medium priority areas included certain areas within the High mountains, South-central mountains and Teklanika mountains subsections of the Alaska Range.

Ecological gaps.--Our examination of the ecological attributes of the pool of expected species indicate that the alpine flora of the Park is well-documented and that the lowland and subalpine areas will require the majority of our plant inventory efforts. Specifically, 165 taxa (58 percent of the total expected taxa) are species that are commonly found in lowland areas, whereas 84 (30 percent) are known to occur in the subalpine zone. Conversely, only 34 (or 12 percent) of the remaining expected species are alpine taxa (Figure A1).

We found that the expected species represent the entire spectrum of site moisture characteristics in the park. This clearly indicates a need for plant inventory work across a broad range of ecological conditions within the unsurveyed lowland and subalpine areas. It is worth noting, however, that there are relatively high numbers of expected species from hygric and aquatic communities (a combined 39 percent) These percentages represent a much higher fraction of wetland species on the expected list than is true for the documented flora of the area. Wetland areas are typically under-represented by *ad hoc* plant collection efforts. Sites across the moisture spectrum will be inventoried within Denali, with a strong focus on wetland areas.

Areas of management concern.--There is a clear need for plant inventory information from the Stampede Trail corridor in Denali. There are long-standing (and imminent) proposals to develop a northern access road into the Park along this corridor, which would have profound consequences for the ecology of this area. This corridor lies mostly within the Toklat Basin subregion, which is not well known floristically. As a result, we have a critical need to inventory areas likely to be affected by this development, if it occurs.

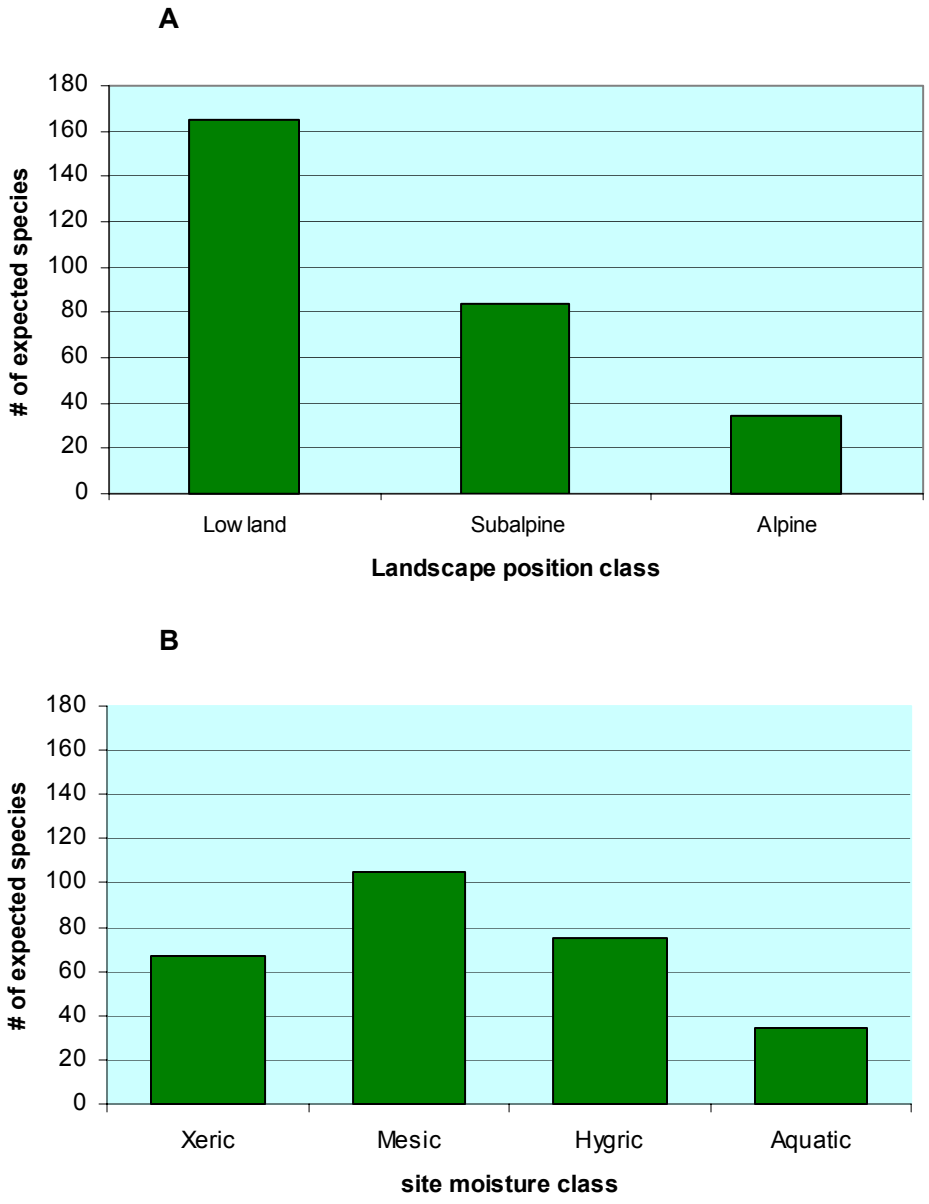


Figure A1. Distribution of Denali expected plant species among A) landscape position classes and B) site moisture classes.

Table A1. The amount of existing plant inventory information for ecoregions and subsections within Denali National Park; priorities for future plant inventory work++.

Ecoregion	Subsection	acreage	amount of existing data •	# plant inventory sites ♦	# new taxa ∇	priority 2000 **
Alaska Range	Kantishna Hills	446,127	Medium	5	17	Low
	Teklanika Mountains	121,175	Low	1	2	Medium
	front range	98,847	High	5	5	Low
	high mountains	1,960,428	Medium	3	10	Medium
	interior mountains & valleys	536,039	Very High	9	9	Low
	south-central mountains & valleys	556,426	Low	14	63	Medium
	Toklat basin	156,227	Low	2	4	High
Cook Inlet	braided floodplains & terraces	55,634	Low	15	26	Low
	glaciated hills and plains	89,819	Low	8	55	Low
Kuskokwim	alluvial fans	1,092,132	Medium (restricted)	0	n/a	High
	glaciated hills and plains	424,958	Medium (restricted)	1	3	High
	low mountains and pediments	92,142	Low	0	n/a	Highest
	Minchumina Basin	391,264	Low	0	n/a	Highest

++ Ecoregion classifications based on NRCS draft ecoregion map (Clark 1999).
• Based on number of collection localities (prior to 1998) within each subsection
♦ sites visited during Floristic Inventory of Denali project 1998-9**.**
∇ number of taxa new to Park list that resulted from floristic inventory sites in 1998-9
****** relative priority for new vascular plant inventory work, based on all preexisting data

Wrangell-St. Elias National Park and Preserve

Targeted survey areas.--Survey areas were selected using the process described above for DENA and specifically after assessing geographical gaps in the existing data, the ecological attributes of the expected list, the distribution of species new to the park's flora from the previous inventory, and the distribution of rare plant species. The mountain and basin regions used in the 1994-1997 floristic inventory data analysis were used for this evaluation (Figure A2). Collection localities (Figure 3) do not represent comprehensive surveys of an area and therefore receive much less weight when evaluating geographical gaps. Survey areas are listed in Table A2 and delineated in Figure A3. The highest priority areas are described below. Accessing the Bagley Icefield and coastal areas of the park are logistically difficult and quite costly. Therefore, it is unlikely that we will be able to survey many other areas below priorities 1 and 2 with funding from this initiative. However, we will select sites within these survey areas in the event that it is possible to coordinate with other inventories during this initiative or with other park projects in the future.

1. *Gulf of Alaska Basin between Yakutat and Icy Bays.* This region has one of the highest unsurveyed acreages in the park (1,080,231 acres) and includes the coastal forests, the Malaspina Foreland uplands, coastal nunataks and extensive wetlands between the forested region and uplands. No comprehensive inventories have been conducted in this region. The FIREPRO collections that have been made from this region almost always represent significant range extensions (>200 km) from prior stations. Coastal nunataks that may have been ice free since the Wisconsin glaciation (Samovar Hills, Floral Island and Blossom Hills) and other unnamed hills at the head of the Malaspina Glacier may be refugia for disjuncts, rare or endemic species.

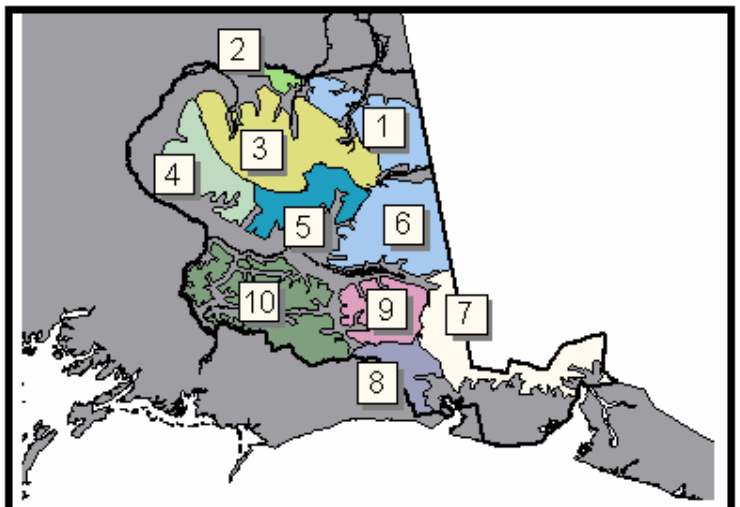
2. *Southern St. Elias Mountains and Bagley Icefield.* These two mountain regions have the highest average acreage by site for the park (545,588 and 466,878 respectively) and the highest average number of new species to the park's flora in the 1994-1997 inventory. One species from this region was new to the state (*Arabis calderi*). A rare Yukon endemic, *Artemisia rupestris* was observed by a Kluane ranger on Mt. Chitina in the park, but has not been verified. This would be a new species to the state if it were verified. This is extremely rugged terrain with numerous nunataks that could have unique communities and species new to the flora. Oral history documents the nunataks in the Bagley Icefield as a travel route to the coast (Russell 1891, deLaguna 1922). We will be seeking additional funding to conduct an interdisciplinary survey of the nunataks for archeological sites, vascular plants and small mammals in coordination with David Hik from the Univeristy of Alberta, Edmonton.

3. *Tanana Lowlands.* There are extensive un-inventoried wetlands in this region which extends up the Chisana River drainage. Only one site was inventoried in this region and it was an upland site in the Carden Hills. The hygric and mesic moisture classes have the highest number of expected species in the interior lowlands.

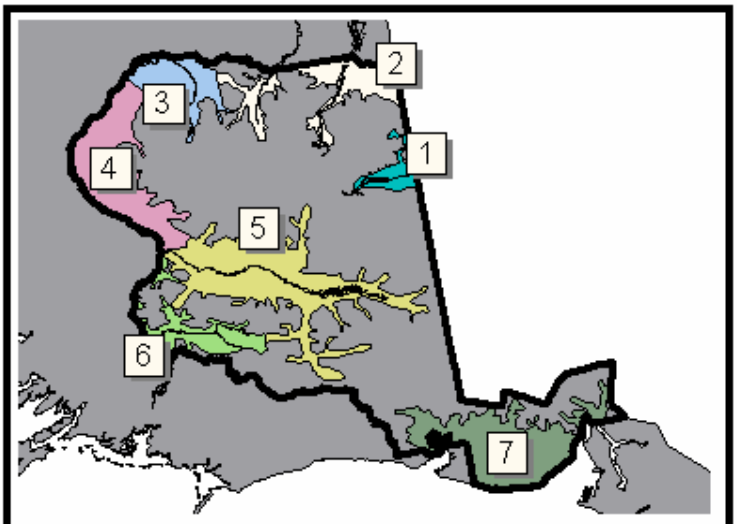
4. *White River Basin*. Only one site has been surveyed in the White River basin an area of 167,923 acres which ranked third in average number of new species to the park in the 1994-1997 survey. River bluffs with steppe communities may have Alaska-Yukon endemic species new to the flora such as *Townsendia hookeri* and *Penstemon procerus*.

5. *Northern St. Elias Mountains between Chitistone Pass and Anderson Glacier.* This is extremely rugged inaccessible terrain that has only had three survey sites for an average of 405,019 acres, third highest for the mountain ranges in the park. Alpine species comprise 16% of the total expected species for the interior, and these are primarily in the xeric and mesic moisture classes.

6. *Northern Wrangells.* High elevation plateaus, scree slopes and river bluffs in this region have been very productive for new, rare species and major disjuncts in our previous inventory (i.e.,



MOUNTAIN RANGES	ACRES	#/SITES	ACRES/SITE
1 - Nutzotin	847,441	31	27,337
2 - Mentasta	122,138	18	6,785
3 - N Wrangell	1,613,873	10	161,387
4 - W Wrangell	706,301	18	39,239
5 - S Wrangell	682,153	15	45,477
6 - N. St. Elias	1,215,056	3	405,019
7 - S. St. Elias	1,093,375	2	546,688
8 - Bagley Icefield	669,296	2	466,878
9 - Granite	933,756	12	77,813
10 - Chugach	1,186,709	32	37,085



BASIN RANGES	ACRES	#/SITES	ACRES/SITE
1 - White River	167,923	1	167,923
2 - Tanana River	566,648	12	24,637
3 - Upper Copper River	435,508	15	29,023
4 - Middle Copper River	899,986	11	81,817
5 - Chitina River	1,450,549	36	40,293
6 - Lower Copper River	436,121	5	87,224
7 - Gulf of Alaska	1,080,231	0	N/A

Figure A2. Mountain and basin regions of Wrangell-St. Elias National Park and Preserve, Alaska.

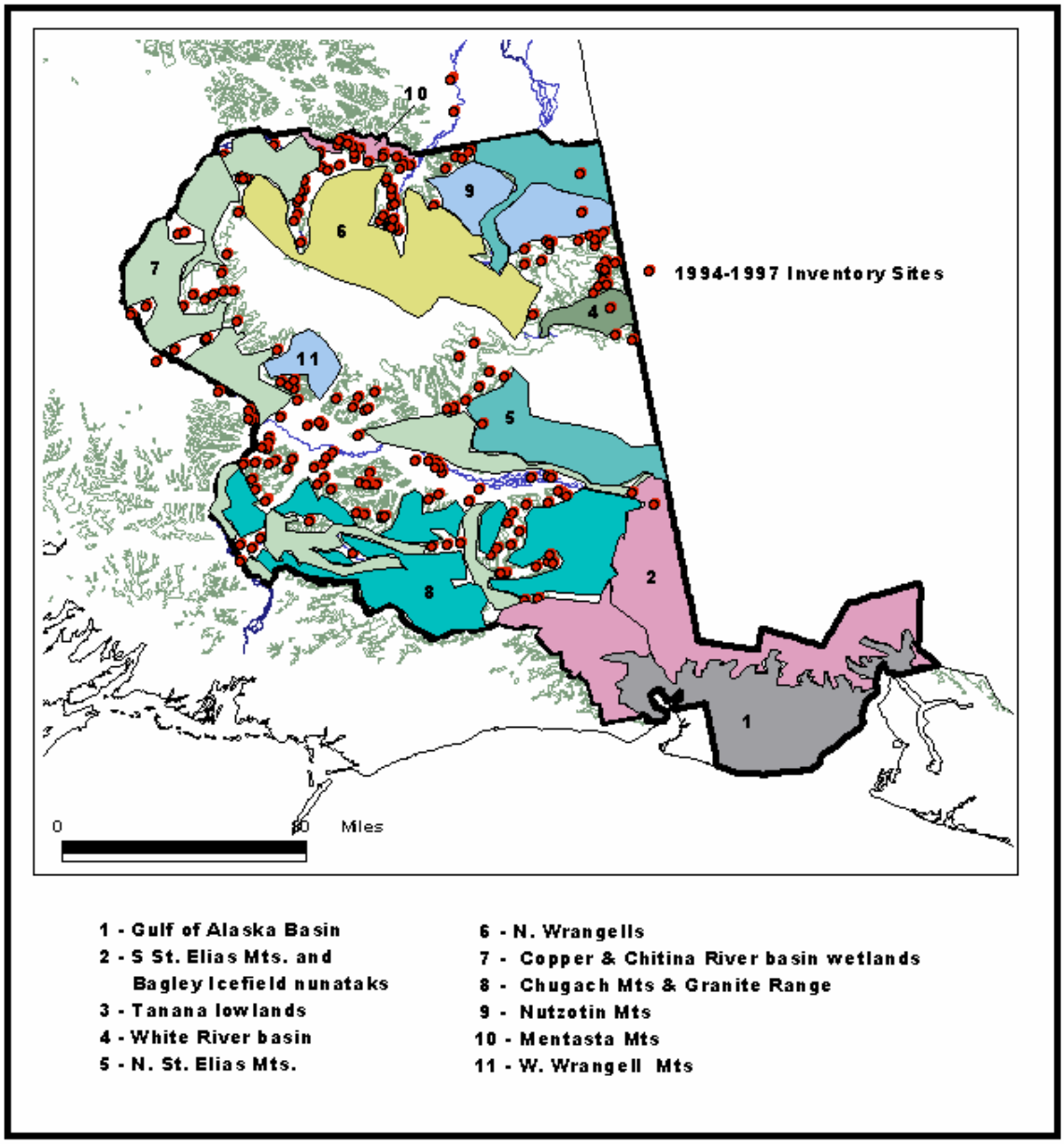


Figure A3. Vascular plant inventory geographic data gaps within Wrangell-St. Elias National Park and Preserve prioritized for future inventories

Table A2. The amount of existing plant inventory information for regions within Wrangell-St. Elias National Park & Preserve, Alaska. Park regions and geographic gaps are delineated in Figures A2 and A3. Sites refer to those surveyed during the 1994-1997 vascular plant inventory. Rare plants are those with an Alaska Natural Heritage Program state rank <= 3.

Regions	Acres	#/Sites	Acres per site	#/Pre-inventory collections	#/New Taxa	#/New Species per Site	#/Rare Plant Localities	Survey Areas/Habitats	Survey Priority
Mountain Regions									
Nutzotin	847,441	31	27,337	16	50	1.61	26	Rare/endemic habitat in 2 areas	9
Mentasta	122,138	18	6,785	2	30	1.67	22	Rare/endemic habitat	10
N. Wrangells	1,613,873	10	161,397	15	24	2.40	20	High elevation plateaus, scree slopes and river bluffs	6
W. Wrangells	706,301	18	39,239	12	17	0.94	14		
S. Wrangells	682,153	15	45,477	13	16	1.07	24	Alpine slopes between Long & Kuskulana Glaciers	11
N. St. Elias	1,215,056	3	405,019	17	6	2.00	12	Alpine slopes between Chitistone Pass and Anderson Glacier	5
S. St. Elias	1,093,375	2	546,688	1	12	6.00	13	Alpine slopes and nunataks	2
Chugach	1,186,709	32	37,085	16	27	0.84	20	All communities S of Bremner R & between Tebay and Hanagita Peak	8
Granite	669,296	12	55,775	5	27	0.44	18	All communities, eastern half of range	8
Bagley Icefield	993,756	2	466,878	0	6	3.00	2	Nunataks	2
Basin Regions									
White R.	167,923	1	167,923	4	3	3.00	6	Lowlands and bluffs	4
Tanana R.	566,648	23	24,637	10	29	1.26	11	Wetlands	3
Upper Copper R.	435,507	15	29,034	10	31	2.07	5	Wetlands	7
Middle Copper R.	899,986	11	81,817	10	26	2.36	7	Wetlands, bluffs	7
Lower Copper R.	436,121	5	87,224	13	7	1.40	3	Wetlands, bluffs	7
Chitina R.	1,450,548	36	40,293	15	59	1.64	17	Wetlands, bluffs	7
Gulf of Alaska	1,080,231	0	n/a	32	n/a	n/a	0	All communities	1

7. *Erysimum asperum* var. *angustatum*, *Phlox hoodii, Colpodium vahlianum* and *Cerastium regelii*). This region ranked fourth in the average number of new species by region, and it has the fourth highest average acreage by site (161,387 acres).

8. *Wetlands and uplands in the Copper and Chitina River basins.* Wetlands have been poorly surveyed throughout the park. The highest absolute number of species new to the park (59) was from the Chitina River basin, one of these being new to the state (*Tricophorum pumilum* var. *rollandii*). The uplands on the northwest slopes of Mt Sanford bordering pre-historic Lake Ahtna may have been ice free during the late Wisconsin glaciation and should be surveyed for endemics and disjuncts.

9. *Chugach Mountains and Granite Range***.** Only a few sites south of the Bremner River and between Tebay Lakes and Hanagita Peak have been surveyed. Also, five of the nine species new to the state were from the Granite Range and Chugach Mountains (*Arabis lemmonii, Arabis codyi, Arabis drepanoloba, Carex petasata* and *Festuca minutiflora*).

10. *Nutzotin Mountains.* Only two sites have been inventoried in the area between the Chisana and Nabesna River and north of Cooper Pass in the western Nutzotin Mountains and only four sites between upper Baultoff Creek, the Chisana River and Nelson Creek in the eastern Nutzotins. Ten of the 24 Alaska-Yukon endemics and 29 of the 72 rare plant species occur in the Nutzotin Mountains.

11. *Mentasta Mountains.* Although our survey effort for this region has been high considering the acreage (18 sites for 122,138 acres), this region continues to produce species new to the park as well as rare species to the state, one of these is a USFWS Species of Concern (*Cryptantha shackletteana*). Twenty-six of the 72 rare plant species occur in the Mentasta Mountains, four of these being unique to this region.

12. *Southwest slopes of Wrangell Mountains between Long & Kuskulana Glaciers:* There are two rare species known only in the park from two sites adjacent to this area (*Thlaspi arctium* and *Douglasia alaskana*) indicating that there may be a unique floristic influence in this region that we have not surveyed.

Targeted survey communities.

1. *Wetlands & aquatics:* Many of the new species to the park came from these communities that are still poorly surveyed. Wetlands to survey include both freshwater and tidally influenced communities such as swamps, bogs, fens, marshes, coastal shores, lakes and ponds.

2. *Rare plant habitat:* Thirty-six of the species new to the park's flora (21%) were rare plants. Results from the 1994-1997 inventory of selected areas within the park indicate the following trends in rare plant habitat: 82% of the 423 rare plant collections were made in the alpine vegetation zone; 79% were made over 4000 ft elevation (35% between 5000 and 6000 ft); 42% were in the barren vegetation type and 41% were in the graminoid-forb herbaceous vegetation type; 75% were in volcanic or calcareous substrates; 57% were in alpine herb-talus slope communities; 60% were in a xeric moisture regime; 45% were on a southerly aspect and 60% were on 20 - 40 degree slopes. Most of these trends are not reflected in the selection of site, i.e., similar ratios of sites by parameter.

3. *Other azonal communities:* steppe (along river corridors), high elevation plateaus, scree slopes, unusual lithologies (calcareous, ultramafic zones) and unusual landforms (nunataks, sand dunes, monadnocks and springs).

Areas of Management Concern.--Visitor use has increased from an estimated 20,000 to 40,000 from 1994 to 1999 in the park (Martin 2000). Users are younger than in the past and seeking a 'soft wilderness' experience, i.e., they seek a backcountry experience with minimal risk. This use is met in the park by air taxi operators who land small fixed winged aircraft throughout the wilderness and backcountry areas of the park. WRST has also been targeted by our legislature and tour companies as a tourist destination to accommodate the overflow from DENA. Those of us at WRST who have seen the trends in the last 10 years in backcountry use are alarmed at the increases and patterns of use. WRST is currently in the early stages of preparing a backcountry and visitor use plan. However, we have no baseline data on natural resources in use areas and very little visitor use data.

As we prioritize actual survey sites during the pre-inventory process, we will give more weight to those sites that could provide access to known backcountry access points for visitors so that we can acquire baseline information on sensitive species and communities in the vicinity of use areas. This will be essential information as we develop our backcountry management plan and as we develop a monitoring program for backcountry use.

Yukon-Charley Rivers National Preserve

The Alaska Natural Heritage Program assembled a database of vascular plant species that are present and expected to occur in Yukon-Charley Rivers National Preserve (Figure 4). Species from this list were added to existing floristic databases in order to examine trends in the ecological and geographic distribution of the expected species in Yukon-Charley Rivers National Preserve.

We added these taxa to existing floristic databases and performed initial examinations of the ecological distribution of the pool of expected vascular plant species for YUCH. This initial gradient analysis indicates that the paucity of floristic data is more broad-based in YUCH than in the other two parks in the Central Alaska Network indicating that all moisture regimes and landscape units will be inventoried. Similarly, the map of existing collection localities shows that the amount of systematic plant collecting has been negligible and is primarily concentrated along major river corridors where access is easiest. Hence, surveys will focus away from the river corridors and across all ecological units.

APPENDIX V. SMALL MAMMAL COLLECTION AND TRAPPING DATASHEETS.

ALASKA FROZEN TISSUE COLLECTION
University of Alaska Museum
National Park Service Inventory

Collector:_____

Preparator:_____ Field #:_____

Species:_____ Sex: M F ?

Country/State_____ Quad:_____

National Park:_____

Specific locality:_____

Latitude:_____ Longitude:_____Authority:_____

Date of death:_____preparation:_____

Nature of voucher (Circle one or more): skin skull skeleton

fluid-preserved whole frozen tissues only other_____

Preserved tissue	#tubes	pres	**Preserved tissue**	#tubes	pres
heart			blood		
kidney			karyotype		
heart & kidney			ectoparasites		
H, K, lung, spleen			nematode		
liver			cestode		
spleen			coccidia		
lung			other( )		
muscle			other( )		

Condition of tissues (Circle one): (poor) 1 2 3 4 5 (excellent)

Repro condition:_____

Measurements (total-tail-hindfoot-efn-weight):_____

Remarks:_____
_____
_____
_____

Small Mammal Trapping Data Sheet

Study Site_____ Date_____ Grid/Loop #_____

Legal Description_____

Latitude_____ Longitude_____ EPE_____

NAD Used_____GPS Type_____

Collectors_____

Cloud Cover_____ Prec._____ Temp(°C)_____

Trap Day	Hour	Line	Station	Trap	Species	Sex	Age	Molt	Weight (gms)	Reproduction			Remarks (Specimen condition, UAM#, etc.)
										Male	Female		
											V	M	

Trap
1 - Museum special
2 - Sherman
3 - Cone
4 - Other

Sex
M - Male
F - Female

Age
1 - Juvenile
2 - Subadult
3 - Adult

Molt
1 - No molt
2 - Molting

Reproduction
Male: (Testes)
1 - Descended
2 - Not Descended

Female: (Vulva)
1 - Perforated
2 - Imporforated

(Mammaries)
1 - Lactating
2 - Large
3 - Small

Cloud Cover
0 - Clear, < 10% cloud cover
1 - Partly cloudy, 10-50% cloud cover
2 - Cloudy, 50-90% cloud cover
3 - Overcast, >90% cloud cover

Precipitation
0 - None
1 - Fog or smoke
2 - Drizzle
3 - Showers
4 - Rain
5 - Sleet
6 - Light Snow